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NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

INTRODUCTORY ADDRESS BY THE CHAIRMAN[1]

IN opening this session of our society, and as an introduction to the subject of this evening's program, I dare take the risk of making a few general remarks.

Our meetings have for object not only to bring before members facts and ideas, but more specially to provoke discussions. I consider a paper without a discussion as an unfinished program, and I sincerely hope that the subject of to-night will lead to a lively exchange of ideas.

For us, if we are worthy of the name of chemists, our God means Truth; and nothing helps so much to correct our views and to arrive at the truth as an honest discussion: "Du choc des idées jaillit la lumière."

I believe that in our meetings we can go beyond the dictates of cold, boresome, uninteresting formality. There is no department of science more closely interwoven with the welfare of humanity than our field of chemistry; indeed many branches of chemistry have a very direct bearing on economics and sociology.

Every speaker who appears before us has the right to treat his subject in accordance with his own sincere convictions. Anybody who speaks about explosives is naturally led to talk of their uses for defensive and aggressive purposes. To deny a speaker this privilege would be as

[1] Delivered at the Chemists' Club in New York City, October 9.

unliberal as to forbid him to talk about alcoholic-fermentation industries because the Prohibition Party thinks alcohol ought not to exist; it would be as if a paper on the uses of saccharine was objected to by the Pure Food Law advocates or as if a discussion on the therapeutic value of chemicals was distasteful to the followers of Mrs. Eddy; it would be as unwarranted as if, in a geological society, a paper was considered as objectionable because it contained statements contrary to the text of the Bible.

The chemistry of explosives has always been narrowly connected with the so-called art of war, and it is almost impossible to talk broadly on one subject, without touching upon the other.

I admit, I consider this a very unfortunate attitude of mind, a sign of the yet very incomplete development of the human race; yet, to the average man, this attitude is predominant. For too many generations our race has been perverted by a pernicious education where writers and artists have glorified and misrepresented war. We are all laboring under the harm which has been done by the so-called classic writers of antiquity whom I shall take the liberty of calling here the "braggarts" of antiquity, for they it were who, in their bombastic rhyme and prose, made so much out of a little scrimmage between a handful of excited fighters, as to make it appear as a feat worthy of the gods. As long as the plastic little brains of our children are influenced by this class of literature, so long will explosives and war go together. Men like Grant, Sherman, Tolstoi, Verestschagin, men who have participated in the horrors of war, do not talk nor write, nor paint the glorification of war.

If I kill a man and take what he has and what he was not willing to give me, you will call it murder and theft, but if some people kill and rob under association rules, they will call it war and conquest. There was a time when agriculture, industry and commerce were considered of very scant importance, because it was so much easier to get rich by conquering other nations and return triumphantly home, laden with plunder and stained with blood, but greeted with the applause of young and old. The Romans and the Greeks and even the armies of Napoleon knew very well how to play this game successfully. I am glad to say that since those times we have made some little progress. Wars are no longer remunerative except to army contractors and newspapers. Statistics show that nowadays it costs every warring nation about one million a day to keep an army in the field. Even then the results for the victor are about as disastrous as in a successful patent lawsuit where patentee and infringer both lose money after they have paid for attorneys and chemical experts. The financial crisis in Germany after the Franco-Prussian war, the present poverty of Japan after two successful wars, are striking instances of all this.

Nowadays people who want to get very rich have surer ways than those of plunder by war: law-makers and lawyers have given them easier opportunities for plundering their fellow-men by the skillful use of so-called "business methods" and so-called "honesty" as defined by law. Sure enough, in the midst of all this live some dreamers who in their visions of the future behold the disappearance of war. I admit I count myself amongst these visionaries, these cranks, these unorthodox, unrespectable people, although I fear that our dreams are still far from complete realization. Nevertheless, the fact that some people dare dream such dreams and

dare dream them in public is already a very hopeful sign. There was a time when even the most radical philosophers of Greece could not conceive a nation without chattel slaves and it is not so long ago that the question of slavery whenever touched upon in this country brought forth ridicule and violent opposition.

The people of the United States by putting in their waste baskets the old solemn formula of the "Divine Right of Kings" have done much to abolish war. But this country did more by showing to other nations that a great, happy, prosperous commonwealth can be built up quicker and surer by the power of higher ideals and of honest work than by war and conquest.

It is a current idea that to be prepared for war is to avert war. This may be quite true, but the main question remains to determine what you call "being prepared for war." I very much believe that if we had had no navy we should never had had a war with Spain and we should not now be burdened with a "Philippine Problem."

Let me remind you of the fact that there are $180,000,000 invested in our fleet that is now in the Pacific which costs the people of this republic a sum of money which would irrigate permanently 6,000,000 acres of arid land and transform it forever into a bountiful, rich agricultural district that would provide permanent, prosperous homes for 120,000 families of good, self-respecting, independent citizens. It would build 60 to 100 great electric power plants. It would utilize some of the natural resources of this country, make them available for transportation, light, heat and power to all citizens of this republic instead of leaving them to be exploited for private gain.

Every battleship which now goes to the junk pile after a few years of parading, costs a sum of money which would enable us to build, equip and endow every time, a splendid university or technical school that would rank with the very best of the world's institutions and the benefits of which would be increasing and everlasting.

Yet I know there are many among my friends who believe that the surest way to avert war is to make it so horrible that nobody dares to engage in it. If the conservative military class had been left to themselves they probably would still be fighting with bows and arrows, but scientists and inventors have been encouraged to give them their support. Whenever a new invention appears, the question is raised immediately, How can it be used in war? Napoleon's interest in Fulton's ship was exclusively inspired by the possibility of using steamships in his war with England. Even nowadays balloons and flying machines receive their main encouragement from those who concentrate their attention on war and its engines.

Let me tell you that this attitude of mind is practically the same as if every time our friend, Professor Bogert, discovers a new synthetic product with a never-ending name, somebody would come around and pay him to make a ripping and killing poison out of it.

The intervention of science and engineering has not only made war more horrible than before, but has shorn away its picturesqueness which used to inspire the Don Quixotes whenever worms killed other worms. Furthermore, the gods of war no longer are influenced by the offerings or sacrifices or clamoring prayers of long-robed priests. They do not even take into consideration the so-called righteousness of the cause. On the other hand, they seem to have become very decidedly partial to the nation whose artillerists do not forget their logarithms during the heat of battle or whose explosives are best nitrated. In-

stead of the bards of olden times who were paid by the war-lords to sing their praise and to tell lies in prose and in rhyme, we now have the modern newspaper. But even if some newspapers are glad to have a war on hand which increases their circulation, they can no longer arouse enthusiasm since their war reporters with their deadly kodaks take away all the bombast from their descriptions and only picture stern, prosaic, nasty reality.

Fortunately for us the study of explosives and engines of war has a broader interest. In the same way as the deadliest of poisons have become some of the most valuable therapeutic agents, so have explosives and engines of war found their most valuable applications in the arts of peace. Nitro-cellulose or gun-cotton, one of the most violent explosives, found immediately its applications in surgery, later on in the manufacture of celluloid and also made possible the photographic film. Shall I call your attention to the splendid example of our fellow chemist, Nobel, who with his valuable work on nitro-glycerine, dynamite and similar explosives, has made his discoveries and inventions incomparably more useful in mining and in engineering than in war, and thus created more good than the harm they ever will do in the art of killing. Noble, too, was one of those who did not love war, and he showed it when, after his useful life, he made of his enormous but well-acquired fortune an international bequest for furthering peace and civilization.

Shall I remind you of the time when chemistry did not exist, when the only encouragement which was given to experimental research was dictated by greed, that tried to make gold and thus bribed the skill of the alchemist? And yet what an immense amount of knowledge was thus accumulated! Knowledge which was afterwards utilized for the benefit of mankind.

Let me remind you also, my friends and fellow chemists, that our God-given mission is to utilize our science for the welfare of our whole race; to develop and improve our knowledge, our thoughts, our aspirations, to lead to a better, a higher, a happier race; a race where individual selfishness and conceit shall not count a life by three score and ten, but a race where an individual and a nation are only considered as temporary cells or groups of cells in an everlasting organism that lives through centuries and æons; and which shall keep on improving and improving towards higher and higher standards; unless ignorance, greed and selfishness make it unhappier and unhappier, until finally it finds a fitful and merciful annihilation and perishes and follows the way of the dead races of animals and plants that have only left their traces on past geological periods, and now proclaim to us that they were not apt, not fit, not warranted to perpetuate themselves.

Gentlemen: I now have the pleasure of introducing to you our distinguished fellow chemist, Mr. Hudson Maxim, an American, who by his discoveries, his inventions, by his originality of thought and action, has shown over and over again that he is most eminently qualified to treat the subject of this evening.

L. H. Baekeland

THE WARFARE OF THE FUTURE[1]

How will the battles of the future be fought? In our reasoning we are obliged to proceed from the simple to the complex, from what we know to what we would

[1] Address before the New York Section of the American Chemical Society at the rooms of the Chemists' Club, 108 West 55th Street, on Friday evening, October 9, 1908.

learn. In order to forecast the future, it is necessary to recast the past.

We are to-day marching in the van of achievement with a vast wealth of accomplishment behind us. Still, relatively speaking, we are merely entering at the very threshold of invention.

When primitive man first learned that with a club as a weapon he could vastly reinforce his teeth and fists and claws, he doubtless thought that there remained but little chance for further improvement in weapons of warfare.

The human hand has been forged from the fin of a fish by the human brain. The hand, in its turn, has built upon the microscopic terminal ganglion of the primitive cordworm the giant brain of a Herbert Spencer, infinitesimal piece by piece. Hand and brain have always worked together in a close partnership.

When we compare the course of human invention with the evolutionary processes of nature, we are struck by the parallelism. Everywhere in nature there is a fierce rivalry that stimulates to improved variation to meet the exigencies of necessity. The complex is evolved from the simple and the large has small beginnings. The intelligently selective grows out of blind inertia tending always toward the survival of the fittest. Had we infinite powers of understanding of natural processes, we should then have infinite foresight too and should be able to forecast with unerring accuracy what the future has in store. A sufficient knowledge and observation of nature would have foretold each before its invention, by some parallelism or counterpart in nature, many of the greatest inventions of man.

The screw propeller would have been foreseen in the tail of the fish. The armored saurian of the reptilian age would have given a foreview of the armored knight of the middle ages, destined to hold the mastery awhile, and doomed in turn, just as the old hard-hided antediluvian monsters went down before the agile sharp-toothed carnivora, to fall beneath the supremacy of the light-footed unhelmeted soldier, without shield or cuirass, but whose powers of offense with firearms become his best means of defense too.

The old flint-lock blunderbuss charged with lead and black gun-powder was thought pretty near perfection as a weapon of war. Still, the coat of mail was laid aside slowly and reluctantly; also slowly and reluctantly with the further improvement in firearms did armies break from solid rank formation and disperse over large areas and fight in skirmishing order.

To-day it has become a recognized truism of military science that victory depends upon the concentration of attack upon the most vital points of an enemy's position, while offering to the enemy the minimum of vital exposure. To this end, wisdom has led to the division and dispersion of the men and enginery constituting the units of attack, while still enabling each attacking unit to concentrate upon any desired point of the enemy's position.

The greatest means of defense are efficient means of offense. The greatest protection against receiving heavy blows is to be able to strike heavy blows. A heavy blow upon an enemy is far better than heavy armor on one's self.

Naval warfare too must soon conform to the wisdom of this lesson, and the battleship, the gigantic armored saurian of the sea, is destined to be dominated in the near future by some agile, swift, sharp-toothed carnivora of destruction.

In ancient times, when men fought with clubs and swords and spears, victory depended upon the actual amount of brute force that could be opposed to brute force,

and little depended upon science. With improvements in weapons, warfare becomes more and more a matter of exact science and the military man becomes more and more a civil and mechanical engineer. In the military land operations of the future, science will more than ever be supreme above mere brute force.

Nothing is more apparent than a simple proposition after it has been well learned. To hitch up a steam engine to propeller wheels and drive a boat looks simple enough to us all now, but when Fulton proposed a steamboat voyage up the Hudson, the undertaking appeared about as incredible to most people of the time as a suggested voyage to Mars would now be.

The old wooden hulk was in its day a dare-devil innovation. He was a revolutionist, in the inventive sense, who first fired heavy guns from a ship's deck. The present battleship is only a highly developed *Monitor,* just as the old wooden sailing ship was a highly developed trireme.

It is the same conservative spirit to-day that believes in the battleship as the final arbiter of national supremacy that once believed in the old wooden-sides and adhered to them, opposing all innovations; the same spirit of conservatism that adhered to the Roman galley and placed its faith in the crew of the galley slaves rather than upon the uncertain wind; the same conservatism that made the Carthaginians adhere to their outclassed triremes; and, in inverse order, it is the same spirit of invention combating entrenched conservatism that led the Romans to build their galleys for close-order work, armed with grappling hooks, with which they secured their vessels to the Carthaginian triremes, where the Roman short sword could be brought into play.

When, in the first Punic war, the primitive Roman fleet met and was vanquished by the Carthaginians, the order of battle was the same as it is to-day. The vessels lined up at such a distance apart as would enable the Carthaginians to strike the Romans with their long-range arrows and the stones hurled by their Balearic slingers. When, however, the Romans devised a means whereby they were able to run them down and grapple with them in hand-to-hand conflict, victory was with the Romans.

The next great improvement in naval warfare will be on the lines of ways and means of repeating what the Romans did—ways and means of charging upon and grappling with the mighty war-vessels of an enemy, to sink them with the short sword of high explosives.

There is no one thing so much needed in naval warfare at the present time as a more efficient means of reaching battleships and cruisers with a sufficient quantity of high explosives for their destruction; in other words, there is a more imperative demand for improvements in torpedoes and torpedo-boats than in any other branch of the naval service.

The effective range of the modern high-power gun is now about five miles, and it is the range of the guns that determines the distance between the lines of battle of modern fleets; and the fleet with guns of the longest range has the opposing fleet at its mercy.

A little while ago the Whitehead automobile torpedo was thought to be a valuable adjunct to the armament of the modern battleship, but the range of the guns has now been so increased that such torpedoes become a useless incumbrance, because of the shortness of their range, notwithstanding the fact that their manufacturers have done everything possible to perfect them and to increase their speed and range. Their range is necessarily limited to that

attainable by the charge of compressed air they are capable of carrying.

During the past few years the air pressure has been increased from 1,300 pounds to the square inch to 2,250 pounds to the square inch, and the weight of air from sixty pounds to one hundred and thirty pounds in the eighteen-inch torpedo; and still the maximum range of the eighteen-inch torpedo is only from 3,000 to 3,500 yards, practically about one-third of the range of the high-power guns which determine the distance apart of the lines of battle; and the maximum rate of speed of this torpedo is about thirty-five knots.

In order to carry the air under the enormous pressure, a very strong and very heavy steel air flask is needed; and as the weight of the entire torpedo must not exceed the weight of the water displaced by it, the propelling mechanism has necessarily to be made very light and delicate for the energy it has to transmit.

But what is far more important, the explosive charge also has to be reduced to a minimum, in order to float the heavy air-flask and the weight of air it contains; and this notwithstanding the fact that the quantity of high explosive ought to be greatly increased in order to ensure destruction of the warship struck by it. In the recent war between Russia and Japan the Whitehead torpedo proved a great disappointment.

If the speed of an automobile torpedo could be increased fifty per cent., its accuracy also would be greatly increased, for it would be far less affected by currents, and would be far more likely to strike a moving target, while if its range could be increased one hundred per cent., it would then become an efficient adjunct to the armament of every war vessel, whereas if its range could be increased to five miles—practically three times what its range now is—even though its speed were to remain at thirty-five knots, it would be able to pass over the intervening space separating the lines of battle of opposing fleets.

During the last ten years I have conducted a large number of experiments at a cost of more than $50,000 in the development and demonstration of a system for the propulsion of automobile torpedoes and torpedo-boats by energy derived from the products of combustion of a self-combustive fuel called motorite, consisting of seventy per cent. nitroglycerin and thirty per cent. gun-cotton. The gun-cotton is gelatinated by the nitroglycerin, forming a dense, tough and rubbery material. This material is made into bars about seven inches in diameter and six feet long, for use in torpedoes the size of the eighteen-inch Whitehead torpedo. For the twenty-one-inch torpedo the stick will be both bigger and longer.

The motorite bars are forced into and sealed in steel tubes for use, and these steel tubes containing the motorite are inserted into the torpedo and are surrounded by a water-jacket. The motorite can be ignited and can burn only at and from one end, and water is forced through the water-jacket into the combustion chamber, to be evaporated by the flame blast forcing the water along with it through an atomizing device, whereby it is instantly converted into steam, and the combined steam and products of combustion form the motive fluid.

The water will be taken in from the sea as required, so that it will not be necessary to carry the water-supply on board the torpedo.

One pound of motorite evaporates a little over two pounds of water, so that one pound of motorite produces the equivalent of three pounds of steam, for the products of combustion of the motorite mingle with the steam produced. The steam from the

combustion chamber is conducted to turbines, or other engines or devices for propelling the torpedo through the water. By means of this system of propulsion, the range of the automobile torpedo can easily be doubled, while at the same time its speed can be increased fifty per cent. The heavy air-flask will be done away with and will be replaced by a shell merely strong enough and heavy enough for structural rigidity.

This will enable the carrying of one hundred and sixty pounds of motorite in place of the one hundred and thirty pounds of air now carried, and as each pound of motorite will evaporate two pounds of water, we have available four hundred and eighty pounds of motive fluid; and as steam and products of combustion of motorite are much more efficient as a motive fluid per unit of weight than compressed air, it is safe to assume that we have available four times the energy now available in the eighteen-inch torpedo.

Instead of carrying but two hundred pounds of wet gun-cotton—the present charge—we should be able to carry three hundred pounds of maximite, which is practically twice as powerful per unit of weight as gun-cotton, while its density is fifty per cent. greater than that of gun-cotton, so that we should have a warhead easily three times as powerful as the present war head.

The thing most needed at the present time is a torpedo-boat capable of passing unscathed through the fire of quick-firing guns of a battleship in order to get near enough to reach her with certainty with torpedoes carrying a sufficient quantity of high explosives in the warhead to ensure her destruction when hit.

It is a recognized truism in the field of invention that when there is a very strong demand for anything against which there is no physical law barring its accomplishment, it is sooner or later sure to be accomplished.

There is an enormous demand for a system for reaching and torpedoing battleships with destructive quantities of high explosives. I am strongly of the opinion that the most effectual way of accomplishing the result is to construct a torpedo-boat in the following manner:

Build the hull of the boat somewhat on the lines of the cigar-shaped automobile torpedo—even a perfect counterpart of the torpedo in shape would serve the purpose well; but I would suggest a little greater vertical than longitudinal diameter. In other words, I would build the boat a little more fish-shaped than the torpedo, and I would construct it so that it would be adapted to travel both upon the surface of the water and in a semi-submerged position, or rather, in a nearly submerged position.

I would drive the boat with gasoline engines under normal conditions, and when going into action—that is to say, in making the run of attack—the boat would be in its nearly submerged position and would be driven by the combined power of the gasoline engines and motorite.

The gasoline engines will be provided with a shift gear, something like that employed on automobiles, so that under normal conditions, that is to say, when the boat is propelled along the surface of the water by the gasoline engines alone, the propellers will be driven at a slower speed, and a speed adapted to the speed of the boat thereby secured; but when going into action in a submerged position and traveling at possibly double the speed, the gear will be shifted so that the propellers will travel at a speed commensurate with the higher speed of the torpedo-boat.

The boat will be provided with a top keel or fin a little thicker than a man's

body across the shoulders at the rearward end, being narrowed down forward, and a conning-tower large enough for a man to stand in erect.

The front end of the superstructure will be sharp, and water will be thrown to right and left and will not obscure the forward view of the occupant of the conning-tower. The superstructure will be subdivided into small compartments, filled with cellulose. The partitions between the compartments will be thin sheet metal.

The whole superstructure, except the conning-tower, will be very light and entirely dispensable, and can be shot away without actual damage to the boat itself. The superstructure will be for flotation purposes only, serving to tie the boat to the surface of the water, while the boat itself will be actually submarine. The superstructure will project above the surface of the water about a foot.

The conning-tower will be protected by thin armorplate thick enough to resist the projectiles of small quick-firing guns, and there will be no danger of being hit by guns of a larger caliber.

It will be extremely difficult to hit either the superstructure or the conning-tower, even with small quick-firing guns, for the conning-tower will not be more than two feet above the surface of the water, and will not exceed three feet in diameter, and will be moving forward at the rate of from forty to sixty miles an hour.

Of course, it will require stupendous energy to propel a submarine boat through the water at so high a rate of speed, and there is nothing available known to me except motorite which can supply the required energy. With motorite, however, we have easily all the energy that may be required for any desired rate of speed until the motorite be entirely consumed.

Enough motorite can easily be carried to drive such a submarine boat at a speed of sixty miles an hour for a distance of thirty miles. This will be sufficient to overtake and sink any battleship that might be sighted. Of course, a speed of forty-five miles an hour can be maintained for a much longer time, probably for an hour and a half, with the same quantity of motorite.

The Whitehead torpedo is in reality a sort of submarine torpedo-boat and what is true of it also holds true of the torpedo-boat I propose. Of course, the keel and superstructure in the boat I propose would offer additional resistance, but, on account of the larger size of the boat and its greater length and the enormous quantity of motorite that may be carried, we shall have available more than enough energy to make up for the increased resistance.

The boat will carry, say, a couple of torpedoes in the prow and launch them when getting within close range of a warship. These torpedoes should each carry at least five hundred pounds of high explosive. It would be better if they carried half a ton each in the warhead.

The cost of the torpedo-boat will be slight compared with the destruction it can work. Besides, there need be only two men on board and the lives of but two men will be endangered anyway, and notwithstanding the danger to the men making such an attack, even though the chance of being killed were to be one in two, or even more, there will be no lack of volunteers for the job.

A portion of what I have just said about my system of propulsion of torpedoes and torpedo-boats appeared in the September number of the *Metropolitan Magazine;* but I have several inventions relating to the construction of torpedo-boats that have never yet been published, and one of these is a method for taking on and discharging water with very great rapidity for the submergence and emergence of a semi-sub-

marine torpedo-boat of the type already described, whereby these evolutions could be performed with nearly the facility with which a duck can dive.

Another invention is a torpedo-boat warhead, carried by or forming a part of the bow of the torpedo-boat itself instead of forming a part of an automobile torpedo to be launched by the torpedo-boat.

I have shown how a torpedo-boat may be made so that it may be safely run through the zone of fire of a battleship to launch its torpedoes at close range. I am, however, of the opinion that a far better way, and one which will be adopted in the near future, will be to employ a torpedo-boat which shall itself constitute an enormous torpedo. It will be a species of ram; but instead of depending upon the steel prow for punching a hole in a warship, it will be armed with a ton of high explosive. How about the crew? No, it will not be necessary to sacrifice the crew. The boat will be made, say three hundred feet in length over all, and a hundred feet of the prow portion of the boat will be wholly dispensable and may be blown away without injury to the boat proper, the boat proper being but two hundred feet long.

The warhead of the torpedo-boat will strike the battleship below its armor belt and the blast of the explosion will be inward and upward through the warship, while the reacting blast of the explosive charge will not be very severe upon the occupants of the torpedo-boat. They will be hurled back by an enormous wave of water, but it will not be a quick, sharp destructive blow, dangerous to the occupants of the boat or to the boat itself.

After torpedoing a warship, the torpedo-boat, with its dispensable bow blown off, will still be in perfect trim to retreat and escape. The crew of the battleship at this juncture will be busy with their prayers.

Of course, this torpedo-boat will not supplant the automobile torpedo, for that will be employed in other evolutions; but for the direct run in upon a warship, this form of torpedo-boat with a ton of high explosive in the warhead will be the main arm of naval service, for nothing under heaven could prevent one of these torpedo-boats from selecting any battleship in any fleet and sinking it without a chance in a hundred of being prevented.

In June, 1897, I delivered a lecture before the Royal United Service Institution of Great Britain, wherein I recommended a gun for throwing aerial torpedoes, that is to say, high explosive projectiles of large dimensions, which would be capable of penetrating the deck of any war vessel or of blowing up any war vessel when striking in the water beside it.

I proposed a gun of twenty-four-inch caliber, which need not necessarily be any heavier than the regular twelve-inch service rifle. I showed that this gun would be capable of throwing a projectile weighing a ton and a half and carrying half a ton of high explosive to a distance up to nine miles, according to the elevation. Our war department has now decided to build some guns of greatly increased caliber for the purpose of throwing heavier projectiles carrying much larger bursting charges of high explosive.

Although the initial velocity of these projectiles will not be as great as those now thrown from our high-power twelve-inch guns, still there will be a far less relative energy lost during flight, and they will have proportionately far greater residual energy, so that the range will still not only be maintained but actually increased, although the trajectory will not be quite as flat as at present.

There is also another enormous advantage of this type of gun, and it is that the

initial pressure need not be as great, so that a gun, instead of losing accuracy very rapidly after only the sixtieth round or so, will retain its accuracy up to several hundred rounds. These are some innovations in the right direction.

High explosives are destined to play a far more important part in future warfare than they have played in the past. There are three ways by which high explosives may be brought to bear upon the warships of an enemy for their destruction. One is in the bursting charge of the high explosive armor-piercing projectiles; another is in the submarine torpedo, either in the stationary submarine mine or the self-propelled torpedo, of which latter the Whitehead is the principal type; and the other is in aerial torpedoes, huge projectiles carrying charges of half a ton of high explosives dropped upon and about the warships of an enemy.

During the last decade the principal progress in the use of high explosives has been in the perfecting of bursting charges for armor-piercing projectiles; and to-day we are able to fire high explosive projectiles from powder guns and to penetrate the thickest armor plate, without explosion until the projectile has passed through the plate, to be exploded behind the plate with a proper delay action fuze.

In the land battles of the future, lines of battle will circle sky line and opposing sky line, and over the stupendous arena missiles of death will shriek and roar, while sharpshooters with silent rifles will make ambush in every copse and hedge and highway. Aerial scouts will race across the sky, some in high flight and others hovering low.

In this age of marvels with which the inventor is constantly surprising us, it does not do to sleep too late in the morning, else when we awake we may find ourselves laggards in the abject rear. Achievement now runs on so fast that it often outpaces the adjustment of our senses, and though we pinch ourselves to prove our wakefulness, still the sense of dreaming intrudes on consciousness and harasses conviction.

Many of us in still full life are able to go back far enough in yesterday to view the present through the wide eyes of wonder, while we are so fortified with expectation for the morrow that we look a second time to be assured whether or not that flock of clouds that skirts the sunset may be a fleet of airships climbing up the sky.

The flying machine is no longer confined to the realm of fancy or imagination, but the conquest of the air is already far advanced, and the era of practical utility is near. The wonder of yesterday becomes the commonplace of to-day, and the marvels of to-day will be commonplace to-morrow.

Now that the flying machine has become an actuality, and as all that now remains to be done is to perfect already existing means and apparatus in order to complete the conquest of the air, it is well for us to forecast some of the adjustments that will be necessary to meet the changed conditions when we shall have our aerial navies of commerce and of war.

That the flying machine will find very wide application in future warfare, there can be no doubt. Furthermore, it will be the demand for the flying machine as an engine of war that will give to the industry its greatest stimulus.

Inventors will have to delve in the depths of their genius in order to develop, perfect and bring the flying machine to the very high efficiency necessary to meet the requirements of government specifications.

There is no other incentive to invention so great as that which impels to the development and perfection of implements of war, for the very security of property, country, home and life itself often depends

upon a little lead over an enemy in war inventions.

Some terrible things have been predicted for the flying machine as a war engine. Many a sanguine inventor has claimed that with the advent of his flying machine, battleships, coast fortifications and cities could be utterly destroyed by dropping dynamite from the air. It is comforting to know that no very great loss of life or property would result from dynamite dropped from flying machines, for the reason that dynamite requires confinement to work very wide destruction.

Dynamite must penetrate and explode inside battleships, earthworks and buildings in order to do very great damage. Half a ton of dynamite dropped upon the deck of a battleship might kill a few men, wreck some of the superstructure and dent the deck a bit, but the destruction would not be widespread and the crew below would be uninjured. Dropped on coast fortifications the damage would be negligible.

Half-ton bombs dropped into the streets of a large city, or on top of the great buildings, would shake a few foundations, break a lot of glass and kill a few people. The blast of the dynamite, not being confined, would rebound up into the air in the form of an inverted cone, and the effect in a horizontal plane would be small.

The flying machine will have very great use in war as a scouting craft for the purpose of locating an enemy and inspecting his position; but the enemy will have his aerial pickets out too, and there will be many a tilt in the air between the warring craft. Then it will be that speed will count for much and there will be intense rivalry between the nations in the production of flying machines that will fly fast and fly high, for those able to fly the highest will have a tremendous advantage over their enemies. It will be the high flyers who will win.

I have noticed that great personal bravery is often a concomitant of great intellectuality, and it is proverbial that inventors are the dare-devilest men in the world; and when the flying machine inventor casts the earth loose and rounds the ecliptic with the Pleiades, leaves the earth road and cup races with Jupiter on the cloud way, or goes toboganning down the sky slide, then the old soldier's oft-spun yarn of how his company mixed their bones with grape and canister, becomes commonplace.

It will be great sport by and by to outrace and override the thunder storm, and there in the bright sunlight look down upon the rolling, seething mass of cloud spitting fire like an angry cat. We shall then seem to have nature at a disadvantage.

In the not distant future, we shall have our automobiles of the air, and in the wars of the future, we shall have our aerial battelships, our cruisers, our torpedo-boats and torpedo-boat destroyers. But they'll be airy, frail and fairy craft indeed compared with the grim steel monsters of the sea.

Although the value of the flying machine in future wars will be mainly as a scouting craft, still its value and importance for that service alone is hard to over-estimate, for the flying machine vedettes will be at once the eyes and ears of the armies of the future; and they will have their use in naval warfare too, for there will be the aerial torpedo scout on the lookout for torpedoes and torpedo-boats, which will signal the approach of danger.

Possibly, too, we shall have our torpedo hawk, taloned with dynamite, which will swoop down out of the sky in swift pursuit of the torpedo or torpedo-boat and blow it up before it reaches its destination. But the torpedo craft will have their sky

guns then and attack will be dangerous work.

The debt we owe the inventor is the difference between all that is ours to enjoy in modern civilized life and the indigence of barbarism. But for the inventor, we should still be denizens of the unbroken forest, clothed in the skins of beasts. Like Antony, the inventor has with his "broad sword quartered the world, and on green Neptune's back with ships made cities." He has hewn highways through the granite hills and web-worked the world with the iron rail.

With his instruments of science the inventor has sounded the deeps of the eternal skies. He has discovered whence Orion came, has felt the pulse of Arcturus, and he knows the fortune and the fate of a million worlds. He has seen them quarried out of chaos far beyond the troubling touch of time; and he views their onward drift toward death in the infinite night and cold of immensity.

He foresees our own bright sun a paling ember on the hearth of time, and he reads our destiny in the scroll of the milky way by light that left its source so long ago that it was already old upon its flight ere Babylon was builded and when the Egyptian pyramids were still unquarried.

In aerial navigation the inventor is obliged to hang his life on the hazard of his mastery of unaccustomed principles, where there are innumerable untried variables—a stunt of the imagination like taking a flight through the fourth dimension.

Aerial naval tactics will include the use of the thunder head to mask manœuvres. When the cloud-hung navies war and ride the storm to battle, then conjecture will attend the fall of slaughtered combatants and wreckage from the sky to know if it be Jove or man that thunders there.

The more highly scientific war enginery becomes the more the game of war will be one that can be played only by the most scientific and enlightened nations.

We, the people of the United States, are to-day dominated by a boundless egoistic obsession concerning our importance and our power compared with the importance and the power of other nations and of other races. This is an outgrowth of our unprecedented prosperity.

Our hitherto isolated geographical position has relieved us of the burden of armaments that other nations have had to bear; but conditions have now changed and the changes are taking place faster than we are waking up to them.

The great increase in the speed of battleships and cruisers, together with their enormously greater size and carrying capacity, has brought the other great war powers nearer home to us and their fleets are now practically at our doors and their vast armies of veterans are almost within gunshot of us.

We have no real army, and though we have a somewhat powerful fleet, England has one far more powerful, and in proportion to our needs for a fleet, ours is the least adequate of that of any country of consequence in the world.

Mr. Reuterdahl told us some ugly things about our navy recently and we were mighty glad when we learned that there was not a word of truth in what he said, and we were made glad again when we learned that the errors of construction which he pointed out would not occur again.

Last winter, President Roosevelt asked for four new battleships and Congress was straightway petitioned by hundreds of prominent turn-the-other-cheekers not to build any battleships. "Shoo, fly, don't bother us. Let us sleep."

We are the greatest industrial people in the world, and we do not want to be burdened with a large standing army. Furthermore, we are fearful that a large standing army would be a menace to our liberties under the guidance of some favorite general or autocratic president.

But we do need *something* of an army, and at the present time we have practically no army at all. The standing army of the United States to-day numbers 75,000 men—mostly engaged as common laborers and servants to the officers. We ought to have at the very least an army of 250,000 men.

The ordnance department asked the last congress for the privilege of keeping important inventions secret and not to make them public by being obliged to advertise for bids for manufacture; but this petition congress has denied.

Water can not rise above its source, and the wisdom of the American congress can not be expected to rise far above the average intelligence of the common people. This is a government of the people, by the people and for the people; and altogether it is the best government in the world for white men to live in. But a government of the few, by the few, and for the few, may make a better war machine.

In Japan, it is only necessary for the Mikado and a few advisers to hold a board meeting and to decide and act upon any measure. Such facility of action as compared with the cumbersone methods of our congress, is like fishing for trout with a light rod and reel compared with fishing with a huge pine tree and making every movement with a derrick.

All the other great powers are arming themselves to the teeth. "But how does this concern us?" asks the American egotist. "We believe that we are the beloved of all the nations. They are all our personal friends."

The present attitude of our American egoism is that we are absolutely without fear. "We have whipped and shall always be able to whip all creation. We are such terrible fighters that guns would only be an encumbrance and burden us in our headlong rush upon the enemy to wring his neck.

"Besides, there is the great American genius which we can draw upon at any time, as we would draw cider from a barrel, and it is only necessary for the conjunction of the American genius with opportunity to make the fantasies of Jules Verne, H. G. Wells and Roy Norton become actualities. The world would have to step in and hold us then or we should do something awful."

Armies can not be made in a day. It takes three years to convert the average citizen into a real soldier. For the first year an army of raw recruits is only a mob.

The modern battalion of veterans is like the flying wedge of a football team—it acts as a unit. How many undisciplined citizens would be required to oppose the onslaught of the flying wedge of Yale? A plain citizen may have the making of a very great pugilist, and still, without training and experience, he could not stand for long in front of a lusty prizefighter.

Arm the American soldier and train him as the soldiers of other nations are armed and trained, and protect him from sickness as the Japanese soldiers are protected, and there is no army in the world that could whip an American army on equal terms.

We do not want to become a great military power and the only way to prevent it is to maintain a navy so powerful as to preclude any possibility of an invasion of a foreign foe—a navy strong enough to withstand any possible coalition against us.

Then we should not need a large standing army. Then we might love and trust our neighbors—but cut their cards.

Should our fleet by any possibility be destroyed, and our country invaded by a foreign foe, it might cost us five billions of dollars and 500,000 lives to dislodge the enemy and to build another fleet such as we would then know we ought to have. Five billions of dollars would build us a navy far larger and more powerful than the combined navies of the world and place us in a position to enforce universal peace.

The peace advocates are so short-sighted that they do not see that if we build but a few guns, we are obliged to slaughter with them, whereas if we were to build guns enough, we could then make war on war and put an end to slaughter.

When we have only a few guns, and not enough to prevent war, then we must use them for killing. If we build guns enough, then we prevent war, and the gun is converted from a death-dealing implement into an instrument for saving life.

HUDSON MAXIM

PUBLIC LECTURES ON MEDICAL SUBJECTS AT THE HARVARD MEDICAL SCHOOL

THE faculty of medicine of Harvard University offers a course of free public lectures, to be given at the medical school, on Saturday evenings at 8, and Sunday afternoons at 4, beginning January 3, and ending April 25, 1909. No tickets are required. Following is a list of the lectures and their subjects, with dates:

January 3—"Fifty Years of Surgery: A Review," Dr. David W. Cheever.

January 9—"Some Things Parents should know about the Teeth of their Children," Dr. Charles A. Brackett.

January 10—"Anatomical Variations," Dr. Thomas Dwight.

January 16—"Auditory Vertigo: Deafness due to Ear Disease," Dr. Clarence J. Blake.

January 17—"Inflammation," Dr. William T. Councilman.

January 23—"Diphtheria and Scarlet Fever," Dr. John H. McCollom.

January 24—"The Circulation of the Blood," Dr. William T. Porter.

January 30—"On the Work for the Relief of the Sick of Various Agencies Other than Medical," Dr. James J. Putnam.

January 31—"Rabies" (illustrated), Dr. Langdon Frothingham.

February 6—"Curvature of the Spine, and School Life," Dr. Edward H. Bradford.

February 7—"Methods of Testing the Acuteness of Vision and Color Perception," Dr. Charles H. Williams.

February 13—"Psychotherapy: Its Use and Abuse," Dr. Richard C. Cabot.

February 14—"Infantile Paralysis and its Treatment," Dr. Edward H. Bradford.

February 20—"The Teeth of Public School Children: How Related to the Children's General Health and Development," Dr. William H. Potter.

February 21—"Psychotherapy: Its Use and Abuse," Dr. Richard C. Cabot.

February 27—"A Study of the Inoculable Tumors of Mice, with Special Reference to Heredity" (illustrated), Dr. Ernest E. Tyzzer.

February 28—"The Hygiene of Pregnancy" (to women only), Dr. Charles M. Green.

March 6—"Glucose," Dr. Lawrence J. Henderson.

March 7—"Pneumonia," Dr. Elliott P. Joslin.

March 13—"Feeding and its Relation to the Infant's Development," Dr. John Lovett Morse.

March 14—"School Life and its Relation to the Child's Development," Dr. Thomas Morgan Rotch.

March 20—"Some Facts as to Disease of the Heart," Dr. Henry Jackson.

March 21—"The Relation of Gastroenteric Conditions to the Development of Early Life," Dr. Charles Hunter Dunn.

March 27—"Dental Hygiene in the School and Home," Dr. Samuel A. Hopkins.

March 28—"State Work in Tuberculosis," Dr. Arthur Tracy Cabot.

April 3—"The Work of the Boston Consumptives' Hospital," Dr. Edwin A. Locke.

April 4—"Psychotherapeutics," Dr. Philip C. Knapp.

April 10—"The Diagnosis and Prognosis of Surgical Affections, with Special Reference to their Early Detection and Treatment," Dr. Maurice H. Richardson.

April 11—"Progress in the Treatment of Cancer," Dr. James G. Mumford.

April 17—"Good and Evil Results of Athletics," Dr. Edward H. Nichols.

April 18—"The Artificial Illumination of Schoolrooms," Dr. Myles Standish.

April 24—"Athletic Sports at Various Ages and their Probable Results upon the Body" (illustrated), Dr. J. Bapst Blake.

April 25—"Louis Pasteur," Dr. Harold C. Ernst.

THE SARAH BERLINER RESEARCH FELLOWSHIP FOR WOMEN

THE committee in charge of the Sarah Berliner Research Fellowship for Women will offer, every two years, a fellowship to the value of twelve hundred dollars, available for study and research in physics, chemistry or biology in either America or Europe. This fellowship is open to women holding the degree of doctor of philosophy, or to those similarly equipped for the work of further research; it will be awarded only to those who give promise of distinction in the subject to which they are devoting themselves.

Applications for this fellowship must be in the hands of the chairman of the committee by March 1 of the year of each award (March 1, 1909, for the first award). They should state as clearly as possible the candidate's claim to the appointment, and they should contain, in particular, (1) testimonials as to the value of work already done, (2) copies of published contributions, or other accounts of investigations already carried out, (3) evidence of thoroughly good health, (4) detailed plans for the proposed use of the fellowship. The members of the committee are Mrs. Christine Ladd Franklin, Chairman, Johns Hopkins University, Baltimore; Miss M. Carey Thomas, President of Bryn Mawr College; Miss Laura D. Gill, President of the Association of Collegiate Alumnæ; President Remsen, of the Johns Hopkins University; and Professor Howell, Dean of the Johns Hopkins Medical School. The donor of this fund is Mr. Emile Berliner, of Washington. well known as one of the perfectors of the telephone and the inventor of the gramophone. It is named in honor of the donor's mother.

THE INTERNATIONAL ASSOCIATION OF MEDICAL MUSEUMS

THE second meeting of the International Association of Medical Museums was held in the National Museum, Washington, on October 18 and 22, in connection with the International Congress of Tuberculosis. This association, formed for the furtherance and promotion of the efficiency of medical museums as storehouses of material useful for teaching and for research as well as for recording the results of research, will also serve as a medium for the interchange of specimens, and for the discussion and publication of technical methods useful in such work. To aid in making this work more generally available, a Bulletin is published in which the papers communicated will appear and through which exchanges may be effected.

All persons engaged in or interested in the work of medical museums are eligible for election to membership in the association, and the list of members is already large and includes many prominent pathologists and medical men from all countries of the world.

At this meeting Dr. W. G. MacCallum was elected president to fill the place vacated by the death of Major James Carroll, the first president, and Dr. Maude E. Abbott, of McGill University, was made secretary and treasurer. Beside the transaction of business and the discussion of questions of organization and policy, the following papers were presented:

"On the Preservation of the Results of Research as Material for Medical Museums," Dr. W. G. MacCallum, Baltimore.

"On the Classification of Museum Specimens," Dr. M. E. Abbott, Montreal.

"Demonstration des photographies en couleur des pièces et des coupes microscopiques," Professor Arloing and Professor Courmont, of Lyons.

"Preservation of Museum Specimens in their Natural Color," Professor Souchon, New Orleans.

"Demonstration of Methods of Mounting Specimens in Gelatin," Dr. Watters, Boston.

"Methods of Mounting Museum Specimens," Mr. E. L. Judah (presented by Dr. Adami, Montreal).

"A Rapid Method of Macerating Bone," Mr. Izzard, Cambridge, England.

"Demonstration of a New Form of Museum Jar," Dr. Warthin, Ann Arbor.

"Demonstration of Anomalies of the Heart," Dr. Abbott, Montreal.

THE SECTIONAL MEETINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION A—Mathematics and Astronomy—will meet for organization on Monday morning, December 28, immediately after the first general session of the association. Monday afternoon will be devoted to astronomical papers of general interest, beginning with the address of the retiring vice-president, E. O. Lovett, president of the new William M. Rice Institute for the Advancement of Literature, Science and Art, of Houston, Texas. The subject of this address is "On the problem of three bodies." On Tuesday the section will hold two sessions which will be devoted exclusively to astronomical papers.

As the American Mathematical Society will hold its annual meeting in affiliation with the association, all the mathematical papers are expected to appear on its program. The sessions of this society will begin on Wednesday morning and extend through Thursday. The retiring president, Professor White, of Vassar College, will give an address on "Bezont's theory of resultants and its influence on geometry," which will be of general interest to scientific men. The complete program of this society and that of Section A of the association will be distributed on Monday morning.

It is hoped that many of the astronomers may attend the meetings of the American Mathematical Society and that many members of this society may avail themselves of the opportunity to listen to the astronomical papers to be read before Section A on the days immediately preceding those of their own special meetings. Titles and abstracts for the Mathematical Society program should be sent to Professor F. N. Cole, Columbia University, while those intended for Section A may be sent to the secretary, Professor G. A. Miller, University of Illinois. Abstracts should be in a form immediately available for publication, and should be accompanied by detailed explanations in case the importance of the results can not be readily determined from the abstract alone.

The usual arrangement for joint meetings of Section B and the Physical Society for the reading of papers will doubtless be made. The last annual meeting at Chicago was a great success and a still larger one is expected at Baltimore. The presiding officer of Section B is Professor Karl E. Guthe, of the State University of Iowa, and the address of the retiring vice-president will be given by Professor Dayton C. Miller, of the Case School of Applied Science. It is probable that one session will be devoted to a program of general interest to all scientists.

The program of Section D—Mechanical Science and Engineering—includes papers by the following: G. M. Brill, Chicago, Ill., L. F. Moody and A. M. Greene, Jr., Troy, N. Y., J. F. Hayford, Washington, D. C., W. G. Raymond, Iowa City, Iowa, N. C. Ricker, Urbana, Ill., J. J. Flather, A. E. Haynes and B. F. Groat, Minneapolis, Minn., C. M. Woodward, St. Louis, Mo., A. H. Blanchard, Providence, R. I., G. W. Bissell, East Lansing, Mich., and the possibility of three or four other papers. The vice-presidential address will be given by Professor O. H. Landreth, of Union College, Schenectady, N. Y.

The meeting of Section E—Geology and Geography—this year will be one of special interest to all geologists and geographers. The president of the association is Professor T. C. Chamberlin, one of our most distinguished geologists. The vice-president of Section E has prepared a most interesting symposium on correlation. The Geological Society of America and the Association of American Geographers will both meet in affiliation with the American Association for the Advancement of Science, and it is proposed to hold a joint meeting of the three organizations to discuss their mutual relations, in order that the officers of the three may be able to plan future meetings for the reading of papers and for field excursions, so that the needs and wishes of all geologists and geographers may be met as fully as possible.

The sessions of Section G—Botany—will convene under the vice-presidency of Dr. H. M. Richards, in the rooms of the botanical department of the Johns Hopkins University,

and will alternate with the sessions of the Botanical Society of America, as at the Chicago meeting. The address of the retiring vice-president, Dr. C. E. Bessey, will be on "The Phyletic Idea in Taxonomy."

Section L—Education—will hold five sessions, three independent sessions and two joint sessions. The topics and speakers for the independent sessions are: 1. The Relation of the Bureau of Education to the Other Educational Work of the Country, President Harry Pratt Judson, Professor Edward C. Elliott, Superintendent E. C. Moore. 2. American College Education and Life, Professors Josiah Royce, Wm. North Rice, President Wm. L. Bryan and others. 3. The Relation of Governments to Education (address of the retiring vice-president), Hon. E. E. Brown, U. S. Commissioner of Education. The first of these sessions will be held on Tuesday, December 29, at 2 P.M.; the second on Wednesday, December 30, at 2 P.M., and the third on Thursday, December 31, at 3 P.M.

One of the joint sessions will be held on Tuesday, December 29, at 10 A.M. with the American Federation of Teachers of the Mathematical and the Natural Sciences at which the topic: The Problems of Science Teaching will be discussed by Presidents R. S. Woodward and Ira Remsen, and Professors John M. Coulter, N. M. Fennemann, George F. Stradling and William T. Campbell. The other joint session will be held on Wednesday, December 30, at 10 A.M., with the American Psychological Association, at which meeting reports of experimental work in educational psychology will be presented and discussed by a number of investigators in this field.

THE ANNUAL DUES OF MEMBERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The permanent secretary of the American Association for the Advancement of Science begs to call the attention of members to the fact that the annual dues (three dollars) for the year beginning January the first should now be sent to him. The financial year of the association now ends on October 31, and the dues for the following calendar year should be paid as soon as possible after that date. The dues are so small and the membership of the association has become so large that the sending of statements involves an expenditure of time and money, which, so far as possible, should be saved. The office of the permanent secretary must be removed to the place of meeting at Baltimore during the last week in December, and the dues should be paid prior to that time. If they are not paid before January 1, there are serious complications in regard to the sending of SCIENCE to members. The association can not make itself responsible for sending SCIENCE to those whose dues are in arrears, as there are some who may regard the non-payment of dues as equivalent to resignation from the association. The back numbers will be sent to those who pay their dues after January the first upon application to the publishers and the payment of postage at the rate of one cent a copy, so far as the edition permits, but the publishers do not guarantee that this will be done. Should the edition threaten to become exhausted, it will be necessary for those who wish to keep their sets of SCIENCE complete to pay for the numbers at the rate of fifteen cents each.

The permanent secretary takes this occasion to remind members of the desirability of assuming life membership in the association. By the payment of fifty dollars at the present time, all future trouble and expense is avoided. The fees of life members are ultimately transferred to the permanent fund, the income of which is used exclusively for the encouragement of research, and those who assume life membership thus contribute materially to the advancement of science.

L. O. HOWARD,
Permanent Secretary

WASHINGTON, D. C.

SCIENTIFIC NOTES AND NEWS

It is announced that the Nobel prizes for 1908 are to be awarded as follows: For chemistry, Professor Ernest Rutherford, director of the physical laboratories of the University of Manchester, England; for literature, Algernon Charles Swinburne; for physics, Dr. Max

Planck, professor of physics in the University of Berlin; for medicine, divided between Dr. Paul Ehrlich, of Berlin, and Professor Elie Metchnikoff, of the Pasteur Institute of Paris.

AT a recent meeting of the board of directors of the Rockefeller Institute for Medical Research, Dr. Rufus I. Cole, of the Johns Hopkins Medical School, Baltimore, was appointed director of the Hospital of the Rockefeller Institute for Medical Research and Dr. Christian A. Herter was appointed physician to the hospital. Work on the hospital buildings is in progress. It is expected that the hospital will be completed and ready for occupancy in November, 1909.

DR. S. F. HARMER, F.R.S., fellow and assistant tutor of King's College, Cambridge, has been appointed keeper in zoology at the British Museum of Natural History.

MR. A. H. KIRKLAND, superintendent of the Massachusetts state work against gypsy and brown-tail moths, has resigned his office.

DR. WILLIAM MORTON WHEELER, who, during the past summer accepted the professorship of economic entomology in Harvard University, has recently been appointed honorary curator of social insects in the American Museum of Natural History, where, until the present year, he had been curator of the department of invertebrate zoology since 1902. At the close of his term of service at the museum, he presented to the institution his entire collection of Formicidæ—the result of many years of earnest effort and study—a gift of such value as to make the museum the possessor of the finest collection of its kind in America and one of the three largest in the world.

MR. EDUARD ESSED, B.Sc. (Edinburgh), has been appointed forest botanist to the government of Dutch Guiana.

PROFESSOR JOHN M. COULTER has been appointed to represent the University of Chicago at the University of Cambridge Darwin memorial celebration.

MM. EDMOND PERRIER and Van Tieghem have been appointed delegates from the Paris Academy of Sciences to the Darwin centenary in Cambridge.

DR. PERCY GARDNER, professor of archeology at Oxford, and Dr. Barclay Vincent Head, some time keeper of the department of coins and medals in the British Museum, have been elected corresponding members of the Prussian Academy of Sciences.

THE council of the University College, Bristol, has appointed Dr. John Beddoe, F.R.S., honorary professor of anthropology.

WE learn from *Nature* that Mr. N. W. Thomas has been selected by the secretary of state for the colonies to conduct an investigation into the laws and customs of the native tribes of southern Nigeria. The tribes to be studied are, in the first instance, those of the old kingdom of Benin, but it is probable that the inquiry will be continued and include the natives of the other West African colonies in addition. Mr. Thomas is leaving to take up his duties in a few weeks.

DR. CHARCOT and his companions left Buenos Ayres, on November 23, on the exploration ship *Pourquoi Pas* for Punta Arenas, whence they will continue their journey to the South Polar regions.

IN reply to an invitation sent him by the president of the Royal Geographical Society, President Roosevelt has promised when he goes to England, about April, 1910, after his journey in Africa, to address the society.

PROFESSOR EDWIN G. CONKLIN, of Princeton University, is to deliver the address at the public semi-annual meeting of the Ohio Eta Chapter of Phi Beta Kappa, Ohio Wesleyan University, on the twentieth of February. The exact title of the address has not been announced, but it is to be in the nature of a Darwin centenary memorial.

THE three hundred and forty-ninth meeting of the Middletown Scientific Association was held in the Scott Laboratory of Physics, Wesleyan University, on December 8, when Gordon Ferrie Hull, Ph.D., professor of physics in Dartmouth College, gave an illustrated lecture on The Electron Theory of Matter.

THE former library building of Oberlin College has been remodeled and is now the

Spear Zoological Laboratory. Some of those who were students under Albert A. Wright, the former professor of geology and zoology, have placed in this building a tablet bearing the words:

To
Albert Allen Wright
for thirty-one years
Professor of Geology and Natural History
in Oberlin College
1874–1905

An expression of the honor and love of its pupils.

Labor that in lasting fruit outgrows
Far noisier schemes, accomplished in repose,
Too great for haste, too high for rivalry.

The Empress Auguste Victoria has presented to the Senckenberg Natural History Society of Frankfort a bust of Goethe by the sculptor Ernst Freese, which has been erected in the entrance hall of the new museum of the society.

Dr. Andrew J. McCosh, professor of clinical surgery at Columbia University and eminent as a surgeon, died on December 2 at the age of fifty years. His death resulted from being thrown from his carriage while on the way to the Presbyterian Hospital, where he had been a surgeon for nineteen years.

The attendance of the joint Conservation Conference, meeting at Washington this week, is composed of men who have been active participants in the work for conservation since the White House Conference. About half the governors have definitely said that they will be present and the others will send representatives of their states. These governors or their representatives are accompanied by the members of the state conservation commissions which have been named during the summer and fall. In addition to these there will be present the special conservation committees which have been formed by twenty-five or more national organizations. The session on the morning of the eighth was a more or less informal gathering in the Red Room of the Willard Hotel for the purpose of organizing. At 4:15 o'clock that afternoon was the general meeting at the Belasco Theater, at which President Roosevelt and President-elect Taft were among the speakers to address the members of the joint Conservation Conference, the Rivers and Harbors Congress, the Southern Commercial Congress and other organizations with allied objects whose sessions in Washington at that time will help to make up what has been called "Conservation Week." After that the joint conference was to take up its business at the Hubbard Memorial Hall. The plan was to take up one after another the main subjects which the National Conservation Commission has been studying—waters, lands, forests, minerals.

At the General Assembly of the International Institute of Agriculture, held in Rome on November 27, Signor Tittoni, the Italian minister for foreign affairs, was appointed president, and M. Muravieff, the Russian ambassador, and Sidney A. Fisher, the Canadian minister of agriculture, were chosen vice-presidents.

A free public museum and scientific laboratory has recently been established in Reading, Pa. The public school board is furnishing the cases for the exhibition of material now on hand. The museum is located in the old boys' high school, recently vacated. The material now on hand is largely of the nature of commercial interests although it is proposed to include all branches of natural history. The administration is under the direction of the Reading school district. Professor Levi W. Mengel is the director.

The Garden of the Gods, is to become by gift of the children of the late Charles E. Perkins, of Boston, the property of Colorado Springs. Papers have been filed whereby the six children and heirs deed to three trustees the 480 acres comprising the Garden of the Gods, authorizing them to transfer the same free of charge to the city of Colorado Springs before January 1, 1911. The tract comprising the Garden of the Gods was secured by Mr. Perkins in 1879, and has always been free to the public. It was his wish that this scenic attraction forever be open to the world, and it is in accordance with his expressed wishes that the transfer is made.

THE Drapers' Company has granted £500, to be paid in five annual instalments of £100, to the Middlesex Hospital cancer research fund to assist the governors in maintaining the investigations which are being pursued into the cause of cancer and its cure.

UNIVERSITY AND EDUCATIONAL NEWS

THE legislature of Vermont has acted favorably upon the proposition to establish at Middlebury College a department of pedagogy for the training of high school teachers. The bill, which has been signed by Governor Prouty, carries an annual appropriation of $6,000.

RICHMOND COLLEGE, at Richmond, Va., controlled by the Baptists of that state, has collected $350,000, required to secure a conditional gift of $150,000 from Mr. John D. Rockefeller.

EIGHTEEN months have now elapsed since the Chancellor's Fund for the further endowment of Oxford University was inaugurated. The committee then appointed under the chairmanship of Lord Curzon to organize the appeal has so far been successful in its efforts to raise the required sum of £250,000 that it has now received gifts or promises of a total value of more than £133,000. Recent subscribers have been: Sir Julius Wernher, £2,000; Mrs. Craig-Sellar, £1,000; Mr. Otto Beit, £500; the Merchant Tailors' Company, £500; Mr. J. Hamilton Beattie, £300; Mr. Gerard Craig-Sellar, £300; the Skinners' Company, £250. Mr. Henry Phipps has added £200 to his original gift of £1,000, and Lord Brassey has given £200 for the School of Geography in addition to the £1,000 promised by him for the School of Engineering.

THE board of managers of Haverford College and the faculty held recently their annual joint meeting. The topics for discussion were the advisability of increasing the number of dormitories, and as to whether it would be well to limit the number of students by raising the entrance requirement.

THE Central Association of Science and Mathematics Teachers, at its meeting held in Chicago on November 28, unanimously passed the following resolutions as embodying the conclusions of the association with regard to two important matters of interest to all teachers of science:

Resolved, That we believe in the recognition and inclusion within our courses of the practical and applied aspects that make possible an appreciable significance and belief in the worthwhileness in practical life of the various subjects studied; and

Resolved, That we believe that the formulation of secondary school courses should be made entirely from the point of view of the needs of the majority of secondary school pupils; and, further, that any course that is best for the majority of secondary school pupils is best for college entrance.

PROFESSOR WALTER S. GRAFFAM, of Howard University, Washington, D. C., has accepted the instructorship in mechanic arts at Smith's Agricultural School and Northampton School of Technology. He will be placed at the head of the mechanic arts department, and will take up his new duties September 1, 1909.

DEANS of faculties at the University of London have been elected as follows: For medicine, Professor S. H. C. Martin, F.R.S.; for science, Professor J. M. Thomson, F.R.S.; for engineering, Professor W. E. Dalby.

DISCUSSION AND CORRESPONDENCE

AN ELECTRIC STORM ON THE WASHAKIE NEEDLES

To the issue of SCIENCE of November 6, 1908, Professor J. E. Church, Jr., contributes an article entitled, "Electric Disturbances and Perils on Mountain Tops." The exceedingly interesting phenomena there described recall a personal experience, vivid and unpleasant, and of like character, but differing enough in detail to render it possibly worthy of being recorded. It has remained until now unpublished, because I feared that as it came from one who had no pretensions to scientific education, it might not meet with credence. What follows happened near the top of some mountains in Wyoming, to the southeast of the Yellowstone Park, generally known on local maps as the Washakie Needles. Visible from a long distance, these sharp gray peaks are somewhat higher than the surrounding range, and two well-known streams, Owl Creek

and Grey Bull, flow from their eastern side and at length join the Big Horn River. The height of these mountains I do not know, but as they rise well above timber line, I think it likely that they are near 10,000 feet high.

Instead of rewriting the story, I transcribe directly from my journal (written on return to camp) such passages as refer to the electric occurrences which I observed during the afternoon of Thursday, August 30, 1888.

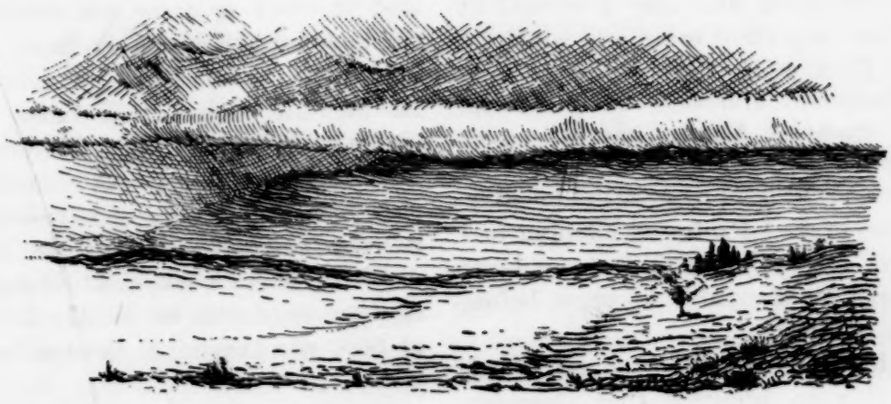
We went up toward the head of the valley, watching the big thunder cloud that we trusted was traveling parallel with our course. One last sheep moved away out of sight, in front, and it became very much colder. Two or three valleys off to the right, long black streamers let down from the cloud, waving mistily just over the pines, and if you looked hard, you saw the water come down in them; but still an uninvaded strip remained between that and where we were, where the air was clear and no drizzling had begun. We went on a little way, and when I looked across again the strip had narrowed and gray bars of rain were falling between us and pieces of woodland that had been unblurred the last time I had seen them. . . . I put on my rubber coat. (This was made like a pea-jacket.) When we got to the head of the valley there was a very much larger cloud coming down on us, you may say, across the wind. We turned, following the ridge toward the big Needle which we had gradually got between ourselves and camp. Below us began a new valley at the bottom of a cauldron. On the other side of the cauldron the air became thick white; then a sheet of storm came across. The cauldron went out of sight, and the hail began at a rate to chip pieces off one's ear. The ground swarmed with bouncing pellets, and they soon filled up the holes between the stones which lay on the hillside. We got down, and huddled each under his horse, and the horse did as much huddling by himself as he knew how. We could see nothing but a general shooting slant of white. All the lines of the mountains were gone. I got the brim of my hat down against my collar, but not before a train of hailstones had rolled down my spine. . . . The lightning was constant, and getting nearer. We were the only raised objects in the district, and we had four guns. So George got away from the group of horses, guns and men and crouched along in the hail, and I crouched after him. Every now and then a particularly ugly crash of thunder would happen, and this would seem to prod George a few feet further away from the dangerous mass of attraction. I did not at all relish the situation. I was chilled all the way through, my shoes had been cold a long while and now grew steadily wet. I dragged off a limp mass of slush, once my glove, and I pondered on the phenomenon of lightning. . . . I turned round and saw Richard's bent head, and Paul wearing a most miserable expression (these two men were Indians), and the shrinking horses, with their tails tucked in and their heads tucked down, and all four feet converging into a pivot under their middles. . . . This gave me a notion of my own appearance, and I roared enough to have made me warm in any other weather but what was going on. The hail melted on my rubber jacket, and trickled down on my breeches where the seat of them was thin by the constant saddle. So far as the look of things went, it was mid-winter and no sign of spring. The pelting lasted a long time, at the same unslackened rate, but at last it began to fall more gently and wetter, and the view thinned out in front till part of the valley came into sight, very faint and with impenetrable hail coming down beyond. Everywhere was white that was not too steep for the stuff to lodge upon. Paul and Dick went off to look over the divide and see if we could go home a new way. And then a thing happened which must seem incredible to any but the man who has knowledge of it by theory or experience. I was wandering about with George, noting the decrease of the storm, when something near my head set up a delicate hissing or spitting. I listened and found it was in my hat. . . . The hail came very fine and gently now, but it began stinging behind my ear worse than it had done at all. Getting tired of this, I turned my face to the wind that was left, and found the hail perfectly harmless, while the stinging behind grew a little sharper. My hat continued to hiss. Feeling very uncanny, I called out to George to know if anything was the matter with his head, explaining what was going on around mine. He nodded uneasily, and drew away from me as if I were an explosive. I connected my hat with the stinging somehow, and pulled it off. The hissing was in the brim, and died out as I stared at the leather binding and the stitching. The pricking behind my ears stopped too. George, a little below me on the hill, complained with his hand up to his head that it was getting unbearable. "Take off your hat," I said. He did, but relief not coming at once, "Take off your spectacles," I added. These

measures were successful, and we discussed what had ailed us. According to George, our hats, becoming damp, had been charged like Leyden jars and, growing overcharged, had unloaded into our heads.

I have made no attempt to change and render more dignified the somewhat informal character of this chronicle. It was written a few hours after the experience in the hail-storm which had not reached the valley where our camp was. When we returned there, we found the aspect of summer as unchanged as when we had left it in the morning. On the top of the mountains the hail stayed only a few hours beneath next day's sun. As we continued our hunt for mountain sheep, there was not a trace of it.

OWEN WISTER

PHILADELPHIA,
November 21, 1908



A NOTABLE CLOUD BANNER

TO THE EDITOR OF SCIENCE: Early in July, 1907, an exceptionally fine cloud banner formed on the southern end of the Bridger range in southwestern Montana. This range, an isolated outlier of the Rockies, trends north and south, thus acting as an obstruction to frequent squally and showery northwest winds which approach it across the Gallatin Valley to the westward. On the occasion mentioned, the writer was camped six miles east of the southern end of the range. Brisk thunder showers from the northwest had occupied most of the afternoon until about five o'clock, after which the sky remained overcast with nimbus and occasional flying patches of fracto-nimbus. Presently little cloud caps began to form on the range, as a result of the adiabatic cooling of a northwesterly air-current forced to rise in crossing the obstruction. They grew rapidly, very soon uniting into a long cloud cap over the whole visible length of the range (five or six miles) and trailing off to leeward from its southern end to a distance of two—a cloud seven or eight miles long in all. The ragged end at intervals sent off scraps resembling fracto-nimbus, which were gradually dissipated as they drifted away from the parent cloud.

The spectacle of a cloud-waterfall over Bridger Peak, the highest portion of the range visible from camp, was nothing short of magnificent. Enormous billowing masses surged one after another across the peak, cascading down the leeward slopes and vanishing in succession as a result of adiabatic warming.

There was no associated standing cloud to leeward. Either the obstruction offered by the range to the passage of the air-current was insufficient, or the current itself was too weak, to set up a secondary wave high enough to raise the air again to condensation level. In this respect the Bridger cloud differed from the clouds over the Cross Fell range in northwestern England, where the famous Helm Bar often tops the crest of a long standing wave to leeward of the mountains. Its occurrence is described by Brunskill in the *Quart. Jour. Roy. Met. Soc.*, X., 1884, 267–275. Professor W. M. Davis reports a similar case for the Cevennes in the *M. Z.*, XVI., 1899, 124–125.

The present phenomenon lasted about two hours, though in its best development not more than an hour. Toward the end the banner gradually decreased in length, the cascading stopped, the cloud cap broke into isolated patches, until finally only a few bits of gray mist remained clinging to the summits.

The accompanying sketch of the southern two thirds of the cloud was made by Mr. H. W. Packard, of Brockton, Mass., from a photograph taken by the writer.

B. M. Varney

Harvard University,
May 19, 1908

THE TRAINING OF INDUSTRIAL CHEMISTS

To the Editor of Science: May I be permitted to offer a few remarks on Dr. Chas. S. Palmer's recent letter[1] regarding the training of industrial chemists and may I correct at least one rather important error into which he has fallen? He says (p. 726):

> But the quotations also show another thing, namely, that Professor Kipping has never been in active responsibility of a chemical works [*sic*] and really does not understand practical industry.

As a matter of fact Professor Kipping had a very active responsibility in a very large chemical works for a number of years, before he became a teacher.

So far as industrial chemistry is concerned, it will probably be admitted that Germany is highly successful in chemical manufactures and that, broadly speaking, England and the United States are not.

It is well known that in the successful German, American and English works two classes of chemists are employed, the "combined analytical machine and foreman" and the investigators. Before being engaged these latter spent eight or more years in obtaining a *chemical* training, and they have to demonstrate their ability to carry out research—by carrying it out. In the English works from which the loudest complaints come—and I believe that the same is true of the United States—it will be found that their "chemist" is a man of very partial training, which seldom exceeds, if indeed it equals that represented by a bachelor's degree. Not only has this unfortunate person had no practise in research, but, as a rule, he is loaded down with routine tests and analyses, and then the manufacturer wonders loudly why the profits do not increase. It speaks volumes for the native ability of his "chemist" that there are any profits at all. In the meantime the dividends of the German works continue to grow.

Judged by results, can there be any doubt which is the better system?

Practically, every technical problem is divisible into two parts. One is purely chemical and deals with such questions as the nature of a reaction, or the conditions affecting the yield of a substance. The second is more essentially engineering and is concerned with containers, transportation, design or construction of plant, etc. We know, however, that in order to carry out successfully independent investigations in pure chemistry, a man must have a suitable mind and, after leaving the high school, must spend about eight years in training. Nevertheless, some manufacturers take an individual who has had only *four years study of chemistry and engineering combined* and expect him to solve problems in *both subjects*. Moreover, certain of these employers are willing to pay as much as $600 per annum to the prodigies in question!

Dr. Palmer's reference to the numerous "fine young students" who "have information by the brainful"—whatever that may mean—is rather funny. His complaint that they can not "apply one thousandth part of what they know" simply proves that they have not been trained in research work. It would be interesting scientifically to be informed exactly as to how much chemistry is represented by 0.001 of the total chemical knowledge of these wonderful "fine young students." It would be more than interesting to encounter one of Dr. Palmer's theories arrayed in overalls, or indeed, in any other garments!

J. Bishop Tingle

McMaster University,
Toronto, Canada,
November 23, 1908

[1] Science, XXVIII., 725, November 20, 1908.

THE TARIFF AND SCIENTIFIC BOOKS

TO THE EDITOR OF SCIENCE: The House Committee on Ways and Means is now holding hearings on the proposed revision of the tariff and is asking all interested parties to appear before it to state their views. Is any one preparing to appear before the committee armed with the necessary facts to show the folly and injustice of the tariff on scientific books written in the English language? Regarded as a means of raising revenue, this tariff is insignificant; regarded as protection, it is an insult. From any other point of view it is simply an oppression suffered by American men of science, whose efficiency is usually impaired besides by incomes insufficient for their needs, and this tariff has for its sole effect to make good scientific work more difficult than it would otherwise be by hindering the ready access to the literature published in another country.

Of course any effort to remove the tariff on English books will be opposed by the publishers of school books, and perhaps also by those who publish popular fiction. The tariff on these classes of books probably does no great harm, and it might be allowed to stand at the present rate of twenty-five per cent.

This being admitted, there arises the administrative difficulty of distinguishing in the custom house between English books which would be dutiable and those which would be on the free list. But this difficulty would not seem to be insurmountable. For example, there is, I believe, a clause of the copyright law which provides for the admission of foreign books to American copyright. Might not the difficulty be met and our object be gained at the same time by the simple provision that all English books which are copyrighted in the United States shall be subject to the present import duty of twenty-five per cent. *ad valorem*, and that all other books may be imported duty free? Under this provision the publishers of school books and popular fiction in America would receive the same protection as at present; while the English publishers of scientific works, for which the demand is too small to be a temptation for reprinting, might be expected to avoid the copyright as an unnecessary expense and a hindrance to the free entry of their books into this country.

R. P. BIGELOW

SCIENTIFIC BOOKS

Climate. Considered especially in Relation to Man. By ROBERT DECOURCY WARD. 8vo, xiv + 372 pp. New York, G. P. Putnam's Sons; London, John Murray, 1908. (The Science Series.)

In 1903 Mr. Ward rendered excellent service by translating and publishing the first volume of Hann's classic "Handbuch der Klimatologie," thus making available to a larger circle of readers the best text-book on the principles of climatology that has thus far appeared. Ward's "Climate" may be regarded as a supplement to the first volume of Hann's handbook, in which the author sets forth clearly and systematically some of the broader facts and relations of climate, primarily for the benefit of the general reader, although the needs of the teacher and student are not overlooked.

The introduction is essentially a condensed synopsis of the first six chapters of Hann's handbook, preparing the way for a better understanding of the chapters which follow. The classification of climatic zones is treated at considerable length, including a discussion on the climatic types resulting from the control of land, water and altitude. Chapters IV. to VI. give an excellent account of the characteristic features of the different zones, and chapter VII. discusses the relations existing between weather, climate and diseases. The three following chapters are devoted to a consideration of the life of man in the three principal zones. In the final chapter the author considers the evidences of change of climate during the historic period.

In the primary classification of climates Mr. Ward wisely adheres to the simple and time-honored classification into three zones—the tropical or warm zone, the temperate or intermediate zone, and the polar or cold zone—

although considerable space is devoted to a presentation of the principal modifications which have been proposed. While there is a great temptation to break away from the established classification and to introduce a scheme more in harmony with the actual conditions in the separate zones, the advantages of the new classifications are not sufficiently great to outweigh the simplicity and established usage of the old. However attractive may be some of the features of the proposed climatic zones of Supan, based upon common characteristics of temperature, rainfall and winds, or those of Koeppen, based upon the relations of plant life to certain critical values of temperature and rainfall of the warmest and coldest months, or of Merriam's biological zones, based upon the distribution of animal life, there are serious obstacles to their general acceptance; they all lack a simple expression for certain definite combinations of temperature, sunshine and winds. The term "temperate zone" is apparently the most objectionable, as the most extreme climates occur within its limits, especially in portions of the northern hemisphere. Still the word well describes the conditions of the zone as a whole, especially in the southern hemisphere. Even in the northern hemisphere fully half the area of the zone has a water surface, insuring temperate conditions. It is only over the continental portions that great extremes of heat and cold occur. Taking the earth as a whole, the terms warm, temperate and cold fairly well divide the climates of the globe into three natural divisions with the tropics and the polar circles as dividing lines. The secondary classification of climates into continental, marine and mountain is simple and practical and has general acceptance.

The author's summary of the characteristics of the three principal zones is especially valuable, as the student will find in these chapters a clearer and fuller synopsis of an abundant literature than is available elsewhere to those who read English only.

Hygiene in the tropics is, according to the author, mostly a question of sanitation, and a rational mode of living, as most diseases only indirectly depend upon climatic conditions. Change of residence, of habits, of occupation, or of food, is usually of more importance than change in atmospheric conditions.

Many problems of great interest relating to the life of man in the tropical, the temperate and the polar zones receive attention in chapters VIII. to X. Such topics as the labor problem and climate, the government of tropical possessions, dwellings in the tropics, race characteristics and climate, climates and crops, mental effects of weather, weather and military operations, are considered, though most of them are necessarily only touched upon. In closing his analysis of the evidences bearing upon the subject of climatic changes in historic times, the author concludes that, "Without denying the possibility, or even the probability, of the establishment of the fact of secular changes, there is as yet no sufficient warrant for believing in considerable permanent changes over large areas"—an opinion shared by most students who have given the subject attention.

Mr. Ward has succeeded in presenting a well-written volume, suitable for the classroom, being methodical in arrangement, and clear and direct in statement. The illustrations are few in number but well selected and neatly drawn.

O. L. F.

Johns Hopkins University,
November 25, 1908

Ex-Meridian Tables. By Lieutenant Commander Armistead Rust, U. S. N. New York, John Wiley & Sons. 1908.

This work is primarily designed to put at the service of the navigator convenient means for reducing altitudes of celestial bodies, when measured within defined limits of hour-angle from the observer's meridian, to the values that they would have if they had been measured at culmination on the observer's meridian, and thus to provide for the application of the simple method of finding the latitude from a meridian altitude, which consists in algebraically adding together the declination and zenith distance of the observed celestial body.

Delambre's equation, in which the whole of the reduction for practical purposes is ex-

pressed in two terms, is employed as the form of reduction to the meridian.

The major term, depending upon the second power of the hour-angle, has been tabulated by the author for each degree of latitude up to 65° and from degree to degree of declination for each two minutes of hour-angle up to sixty minutes or to such lesser extent as marks the limit at which the minor term of the reduction amounts to less than 45″.

The second or minor term of the reduction, depending upon the fourth power of the hour-angle, is expressed in the form of a diagram, from which the numerical value of this part of the reduction may be readily determined.

As the intervals between the arguments of the tabulation of the major term are such that in general the tables must be entered with the approximate latitude and the approximate declination and the approximate hour-angle, convenient auxiliary tables have been supplied for taking account of the effect upon the result of differences between the exact values and the tabular values of the data. Various other diagrams and tables, providing for the identification of stars, facilitating the solution of the equation of equal altitudes, and reducing measured altitudes to true altitudes are also presented to contribute to the completeness of the work.

A navigator who makes this book one of his possessions and utilizes the information contained in it will be repaid many times through the practical benefits that he will derive from it in his daily work. G. W. LITTLEHALES

Chemische Krystallographie. By P. VON GROTH. Vol. 2. Pp. viii + 914, 522 figures, 8vo, cloth, 32 marks. Leipzig, Wilhelm Engelmann. 1908. (Volumes 3 and 4 are in preparation.)

Two years ago the first volume of this very important work by Professor P. von Groth appeared. Since then the volume has proved of such great assistance to all interested in crystallized substances, but more especially to the chemical crystallographer, that the second volume, which was promised over a year ago, has been eagerly awaited. A review of Volume 1 may be found on pages 143 and 144, Vol. XXV., of SCIENCE.

In Volume 2 the inorganic oxy- and sulfosalts are discussed. The arrangement of the first volume is retained throughout. This consists of placing together all compounds of similar chemical composition and prefacing each group with a critical résumé of the work done upon the same, so that one can see at a glance what gaps exist and also along what lines further research may be necessary. This feature alone makes the work invaluable. The descriptions of the individual members of the group, which then follow, furnish all the data extant which are of use or interest to the chemical crystallographer. This volume is in every respect up to the high standard set by Volume 1. It is hoped that the remaining volumes, 3 and 4, may follow in rapid succession.

EDWARD H. KRAUS
MINERALOGICAL LABORATORY,
UNIVERSITY OF MICHIGAN

House Painting, Glazing, Paper Hanging and White-washing. A book for the householder. By ALVAH HORTON SABIN, M.S. 8vo, cloth, pp. 121. New York, John Wiley & Sons. 1908.

This is a thoroughly reliable, readable book, dealing with the subjects of exterior and interior painting, varnishing, papering, kalsomining, white-washing and the painting of structural metal. Technical terms and long-winded descriptions are avoided, and the book should be read by every house user and owned by every house owner. The author's statement to the effect that "the talk about people being poisoned by arsenic in wall paper is nonsense," is unfortunate, as the reviewer knows certainly of one case proved to be due to this cause. A. H. GILL

Modern Pigments and their Vehicles, their Properties and Uses, considered mainly from the practical side. By FREDERICK MAIRE. 8vo, cloth, pp. 266. New York, John Wiley & Sons. 1908.

This is a most excellent book written by one who evidently knows the practical side thor-

oughly. There are several books which are more scientific and chemical, but there is none which will be of greater value to the chemist, the practical man or the young apprentice at the painter's trade. As an illustration of this may be cited the reason—which the reviewer has never seen before given—why American linseed oil is inferior, owing to the fact that it is made from unripe seed. Other good features of the book are the tables of color synonyms and for preparing tints.

No mention is made of artificial graphite, corn or Chinese wood oil or wood turpentine.

A. H. Gill

Man in the Light of Evolution. By John M. Tyler, Amherst College. New York, D. Appleton & Co.

Nothing could be more suggestive of the change that has come over the attitude of thought toward modern scientific ideas than this book. A generation ago our scientific fathers were in the midst of a bitter contest with the world of theistic thinkers over the truth and meaning of the doctrine of evolution. Evolution and atheism were regarded as going hand in hand, and any one who was inclined to look with kindness upon the possibility of human evolution was regarded at once as a foe to any and all forms of theism. One can not read this book of Tyler's without being impressed with the wonderful change in standpoint which a generation has produced. Not only does the work accept without question the doctrine of the natural origin of man, but its central aim is to show that the goal of evolution in the human race is to be found along the line of religious instincts, and that the church to-day is the expression of this highest development of evolution. To our fathers of a generation ago, both theistic and scientific, this would have seemed the strangest radicalism; to us to-day it seems natural and deserving of earnest thought and favorable consideration. Nothing can be more indicative that a new era in this discussion has arrived than the reading of this work.

The book traces, in a most sketchy manner, it is true, the salient features of animal evolution; the production of a stomach by the Cœlentera; of muscles by the worms; of a backbone by the vertebrates; of a brain by the mammals; and of mentality by man. It concludes that the highest phase of mentality which is now unfolding itself involves the expansion of righteousness, of unselfishness, and of the religious instinct. Not only does the religious idea become a part of evolution, but the evolutionary doctrine becomes the interpretation of the religious idea. Truly "the stone which the builders rejected, the same has become the head of the corner."

The tone of this discussion is eminently optimistic, as indeed must be any discussion of evolution that takes a broad conception of this doctrine. The indisputable law that the best adapted *must,* in the long run, be the victor, leaves no room for anything but advance, and hence for optimism. The only disquieting suggestion is, that some phases of life which we think "best" are not best. Of course, many a side branch, adopting lines of ease which led downward, will disappear; but they disappear because something better takes their place. Even the alarming tendency that has been so emphasized in recent years, towards the decreased reproductive rate among the higher classes, receives its interpretation in this discussion. These classes have adopted the easier line of life and are simply following the universal law of nature toward extinction, in order that their places may be taken by those races or classes that have retained their hold upon the line of possible advance, instead of rejecting it for the easier life. Each generation is only an incident in the great purpose of the ages, and many a side line is crowded out of existence by the greater adaptability of the central line of advance. Advance is the law of nature, and with this great doctrine of evolution fully realized, only optimism is possible.

Many other phases of the evolution doctrine are touched upon in this work that can not be referred to here. Professor Tyler is to be thanked for presenting thus a wholesome picture of the progress of the ages from a somewhat new standpoint.

H. W. Conn

SPECIAL ARTICLES

RECENT DISCOVERIES IN THE HISTORY OF THE COMMON EEL[1]

No fish is more generally and widely known than the common eel and none has been involved in more mystery. The absence of developed sexual organs has given rise to many strange hypotheses and fables. The true history has been made known only within the last two years. The most satisfactory of recent observations have been made by Dr. Johannes Schmidt, Dr. C. G. J. Petersen and K. J. Gemzöe, of Denmark.

It has long been known that the eel descends into the sea to spawn, but the exact destination has been unknown. For information respecting this, we are indebted to Dr. Schmidt, who has in great detail recorded the results of two expeditions to ascertain the facts.[2]

None of the eels found in the ocean had fully matured eggs, and the ovaries were only moderately developed. Indeed, according to Schmidt, as recently as 1906, "no one had yet succeeded in finding [in the males] spermatozoa, nor in the female eggs which were larger than 1/3 mm. in diameter, much smaller as a rule, and never clear as the eggs of other species are known to become before spawning. No one had yet described the eggs of the eel in a condition near to spawning or even approximately mature."

The period between the descent into the sea and the appearance of larvæ near the surface has yet to be known, but larvæ have been found by Dr. Schmidt in regions where the depth of the water was about 1,000 meters, and he has concluded that "the eel spawns out in places of at least nearly 1,000 meters depth." In such places, in May and June (especially about the middle of June), larval eels about three inches long are to be found. They are then mostly in the typical leptocephalus stage, diaphanous and without pigment cells, having very compressed and high or ribbon-like bodies, anus far behind, very small heads, large eyes, pointed snouts and full sets of slender teeth directed forwards in the jaws. During the succeeding months, a transformation takes place, in some early, in others delayed.

The body becomes reduced in height, especially backwards, and expands sideways, "the hindmost portion of the gut disappears," and the anus gradually advances forwards, the head at last is less disproportionate and the eyes relatively small, and, above all, the slender spike-like teeth, so characteristic of the typical leptocephaline stage, are dropped. By September and the later autumn the leptocephali of summer have mostly undergone their transformation into a later leptocephalus stage.

All this time the larval eels remain in the ocean not very far below the surface, quite near, it may be, at night, sinking downwards more or less during daylight. Late in the season they gradually approach to the shores, continuing meanwhile their change from leptocephalines into true eels. The time of their entrance into the mouths of rivers depends to some extent on the distance of those mouths from the line of about 1,000 meters or over 500 fathoms. In France, as well as Ireland and England, for instance, they may begin to enter streams as early as January or February, while in Denmark and Norway, none enter earlier than March, and the chief incursion is during April.

During the entire time from the appearance of the leptocephalines near the surface of the ocean to their entry into the rivers, the hyaline condition of the little fishes continues. The body is so diaphanous that only by the closest attention can it be detected, and then chiefly because the eyes are prominent and distinctly colored. Indeed, the first thought on seeing a school of leptocephalines may be wonder that so many eyes are floating about.

The diaphanous condition undoubtedly is an efficient protection against many of the dangers the larval eels encounter. Nevertheless it is only a partial protection. The course of the young fishes riverward is beset with dangers, and these increase as the coast is ap-

[1] Presented to the Biological Society of Washington, October 17, 1908.

[2] Schmidt (Johs.), "Contributions to the Life-history of the Eel (*Anguilla vulgaris* Flem.), Rap. et P. V. Conseil Int. Expl. Mer., V., p. 137–274, pl. 7–13, 1906.

proached. Fishes of the high seas intercept many; still more become the food of the large fishes of the banks and coasts, and of such is especially the cod. That voracious fish rises to them and inflicts great slaughter.

The later changes of the larva into a miniature eel are especially remarkable. Instead of growing larger, the little fish grows smaller and smaller, so that an individual that had been over three inches long may shrink to a length of not more than two inches, and the ribbon-like form may dwindle into a thread-like body. Increase is concentrated into growth sideways and with this the diaphanous character is lost. Meanwhile, "pigment is developed, first on the end of the tail, later on the neck, and lastly over the greater part of the dorsal and lateral aspects."

The gradual changes thus indicated have been segregated by Schmidt into six groups or stages, based on specimens obtained by him.

During all the gradual metamorphosis so illustrated, and which takes a full year for completing according to Schmidt, "the larvæ do not take any nourishment." This abstinence from food has been determined by Grassi and Calandruccio and A. C. Johnsen, as well as Schmidt. Johnsen "investigated over thirty specimens from the North Sea and the Danish waters and found the alimentary canal empty in all of them."

The young eels or elvers that in spring commence their ascent of the streams, which become their homes, must be the offspring of old eels which left the streams not during the last autumn, but the one preceding that; consequently, about a year and a half must intervene between the time a parent eel begins a journey to fulfill her procreative duties and that when the offspring is ready to take up its life under similar conditions. This is a history very different from any ordinary fish's, and so far as known unique outside of its genus.

The growth of the eel in fresh water has this year, 1908, been elucidated by Mr. Gemzöe from examination of the scales.[3]

[3] Gemzöe (K. J.), "Age and Rate of Growth of the Eel," Rep. Dan. Biol. St., XIV., p. 10–39, tab. 14, 1908.

The young eel lives and grows for some time without scales. Indeed, "it has lived in [Danish] waters two years, reckoned from the time it arrives as montée (glass-eel, elver) in its early migration"; it is then about 7 inches (18 cm.) long. The scales grow only during the warm months (June to September) and the intervals of arrest of growth differentiate the growth of the respective years. The early years are passed with a yellowish belly. "The females become silver later, scarcely before they are six and a half years old, the majority not before they are seven and a half years, and many indeed only become silver when they have been eight and a half years" in fresh water. If to these figures we now add a year and a half for the time the eggs are being matured and the leptocephalus stage developed, it appears that an eel must be from eight to ten years old before it assumes the livery of maturity and descends into the ocean to reproduce its kind.

Theo. Gill

Smithsonian Institution

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA

The ninth meeting was held at the Hotel Victory, Put-in-Bay, Ohio, August 25–28, 1908. In addition to the reading of papers, the society appointed two committees: one on luminous meteors, consisting of Messrs. Abbe, Elkin and Peck; the other on comets, consisting of Messrs. Comstock, Pickering, Barnard and Perrine. Officers were elected as follows:

President—E. C. Pickering.

First Vice-president—G. C. Comstock.

Second Vice-president—W. W. Campbell.

Secretary—W. J. Hussey.

Treasurer—C. L. Doolittle.

Councilors for 1908–10—W. J. Humphreys and Frank Schlesinger.

We give below a list of papers presented at the society's sessions, together with brief abstracts:

Formulas used for the Reduction of Satellite Observations: Asaph Hall.

Doolittle's Measures of the Hough Double Stars: G. W. Hough. (Published in *Popular Astronomy.*)

The Standard Clock at the U. S. Naval Observatory: W. S. Eichelberger.

In December, 1906, in an address before the American Association for the Advancement of Science (SCIENCE, March 22, 1907, p. 451), I presented a table showing the daily rates of the standard clock of the U. S. Naval Observatory, Riefler Sidereal Clock No. 70, from February 8 to May 12, 1904.

This clock was enclosed in an air-tight glass case and was mounted in a vault where the temperature was artificially controlled. However, during the period mentioned it was found impossible to prevent air from leaking into the case so that a nearly uniform pressure was maintained by pumping out 1 or 2 mm. a day. The mean difference between the computed and observed daily rates for that period was 0ˢ.015.

DAILY RATE OF RIEFLER SIDEREAL CLOCK NO. 70

Date	B	Obs. Rate	Comp. Rate	$0-C$
1905	mm.	s.	s.	s.
Feb. 6.6	681	−0.0074	−0.0173	+0.010
10.6	681	−0.0055	−0.0187	+0.013
14.4	681	−0.0386	−0.0199	−0.019
17.5	681	−0.0127	−0.0211	+0.008
20.6	680.5	−0.0317	−0.0163	−0.015
24.5	680.5	−0.0310	−0.0178	−0.013
Mar. 1.7	680	−0.0144	−0.0131	−0.001
6.3	679.5	−0.0038	−0.0089	+0.005
10.5	679	+0.0038	−0.0038	+0.008
13.5	679	+0.0125	−0.0053	+0.018
18.3	678	−0.0048	+0.0050	−0.010
25.5	678	−0.0209	+0.0031	−0.024
28.5	678	+0.0199	+0.0019	+0.018
31.5	678	+0.0113	+0.0010	+0.010
Apr. 2.6	677.5	+0.0062	+0.0060	0.000
7.6	677	+0.0043	+0.0101	−0.006
13.5	677	+0.0098	+0.0084	+0.001
17.5	677	−0.0019	+0.0072	−0.009
20.6	677	+0.0118	+0.0058	+0.006
24.5	677	+0.0173	+0.0046	+0.013
27.5	677	+0.0146	+0.0031	+0.012
May 2.5	676.5	−0.0079	+0.0074	−0.015
7.5	676	+0.0154	+0.0118	+0.004
12.5	676	+0.0074	+0.0103	−0.003
16.4	676	+0.0058	+0.0091	−0.003
19.5	676	−0.0014	+0.0077	−0.009
23.6	676	+0.0072	+0.0067	0.000
25.6	675.5	+0.0082	+0.0113	−0.003
June 1.5	675	+0.0137	+0.0154	−0.002
5.4	675	+0.0235	+0.0139	+0.010
9.5	674.5	+0.0142	+0.0187	−0.004
13.4	673.5	+0.0403	+0.0300	+0.010
16.4	673	+0.0312	+0.0350	−0.004
19.5				
			Mean	0.009

Immediately following the period named, we succeeded in making the glass case air-tight and during the past four years have had practically no trouble from leakage of air. I therefore desire to present to this society a discussion of the daily clock rates of this same clock from February 6 to June 19, 1905.

The following table gives the dates of observations, the mean pressure in the clock case, the observed daily rate, the computed rate and the difference between the last two. The change in the pressure is due to a progressive change in the temperature of the clock vault. The computed rates are obtained from the formula

$$+0^{s}.00255 - 0^{s}.01247\,(B - 677^{mm}.5) - 0^{s}.000366\,(T - \text{April } 14.5)$$

deduced from a least-square solution of the observed daily rates. The mean difference between the computed and observed daily rates is 0ˢ.009.

The behavior of the clock can also be shown from the clock corrections during the same period. Each clock correction depending on ten or more time stars has been reduced to April 15.0 by the rate formula given above with the following result:

CORRECTION TO RIEFLER SIDEREAL CLOCK NO. 70, APRIL 15.0

Date of Observation 1905		Clock Correction s.
February	6.5	−14.33
	10.7	−14.29
	17.5	−14.30
	18.3	−14.29
	20.6	−14.28
	24.5	−14.34
March	10.5	−14.40
	13.5	−14.37
	15.5	−14.33
	25.5	−14.36
	27.5	−14.40
	28.5	−14.44
	29.5	−14.45
	30.5	−14.44
	31.5	−14.38
April	8.5	−14.38
	13.5	−14.40
	14.6	−14.43
	17.5	−14.39
	18.5	−14.40
	19.5	−14.42
	20.5	−14.42
	22.5	−14.40
	24.5	−14.40
	27.5	−14.36
May	2.5	−14.30
	12.4	−14.39
	19.5	−14.41
	22.4	−14.42
	23.5	−14.45
	24.4	−14.44
	25.5	−14.45
June	1.5	−14.44
	2.5	−14.42
	9.5	−14.42
	19.5	−14.44
	Mean	−14.39

The mean of the residuals obtained by subtracting — 14ˢ.39 from each of the above clock corrections is 0ˢ.04.

Observations were discontinued for some weeks beginning the latter part of June, so that, in order to show how well the clock correction could be predicted a new rate formula was deduced using the observations from February 6 to June 1. Using this rate formula

$$+ 0^{s}.00207 - 0^{s}.01230\ (B - 677^{mm}.5) - 0^{s}.000373\ (T - \text{April } 14.5)$$

and the clock correction for April 15.0 as — 14ˢ.39, the predicted clock corrections for June, 1905, were obtained as given in the accompanying table:

CLOCK CORRECTIONS FOR JUNE, 1905

Date	Sid. Hour	Predicted Correction	Observed Correction	$O-C$
		s	s	s
June 1.5	16.8	—14.04	—14.06	—0.02
2.5	16.6	14.03	14.01	+0.02
3.5	16.5	14.01	14.04	—0.03
8.5	16.3	13.95	13.91	+0.04
9.5	16.5	13.93	13.90	+0.03
13.4	14.8	13.85	13.85	0.00
14.4	16.1	13.82	13.88	—0.06
18.5	18.6	13.69	13.66	+0.03
19.5	16.9	—13.65	—13.63	+0.02
Mean		—13.886	—13.882	±0.03

Illumination of the Reflex Zenith Tube: C. L. Doolittle.

As the instrument was originally constructed, the field was illuminated by a small electric lamp placed outside the tube, the light from which fell on a diagonal reflector in the axis of the instrument. The mirror was only eight inches from the micrometer threads. The result was that when the thread was not practically in the axis the reflection back and forth from the under side of the prism and the mercury surface produced a feathery appearance in the threads, making it impossible to obtain a sharp image of the same.

After considerable discussion and some experimenting the following plan was adopted:

The smallest electric lamp obtainable—sometimes called a dental lamp—is placed in the axis of the instrument, six inches above the mercury surface. This is held in place by a thin strip of brass attached to the tube in such a way that it may be readily removed in case repairs or removal of the lamp are called for. The current is furnished by a dry battery, and the brightness controlled by a rheostat. It is all of home construction and gives perfect satisfaction.

On the Constancy of the Period of the Variable Star, M5 (Libræ) No. 33: E. E. Barnard.

This is one of the Harvard cluster variables and has been under observation with the 40-inch for nearly ten years. The period derived from these observations is

$$12^{h}2^{m}7^{s}.3040 \pm 0^{s}.01781.$$

The period was independently determined from normal observations at intervals of one or two years. The deviations among these values did not exceed 0ˢ.065. Though this is approximately progressive with the time, it is not believed to be real.

An observation of the variable at its most rapid light change is subject to a probable error of about ± 1.2 minutes, which, when three or four normals are employed, is reduced to ± 0.5 minute.

The light curve shows that the star, after remaining faint for a large part of its period, rather suddenly begins to brighten and in one hour has reached maximum. It remains but a short time at maximum. The decrease for the first half hour is almost equally as rapid as the rise. It then fades slowly for the next six or eight hours to minimum. The entire light change is about 1.2 magnitudes from $15^{m}\pm$ to $14^{m}\pm$.

The Photoheliometer: Chas. Lane Poor.

By an arrangement with Professor Frost a 25-foot photographic heliometer was mounted upon the tube of the 40-inch Yerkes telescope. The lenses were 2 inches in aperture and were specially made for this work by Brashear. The centers of the lenses were at a fixed distance apart and this distance was so adjusted as to make the photographic images of the sun overlap. The common chord of these overlapping images is a measure of the diameter of the sun, and slight variations in the diameter produce relatively large changes in the length of the chord.

During 1907 a series of photographs were taken by Mr. Fox, but owing to bad weather the number was rather limited. They were sufficient, however, to test the value of the method and to show the general lines upon which an instrument should be built.

A Possible Third Body in the System of Algol: R. H. Curtiss.

Spectroscopic determinations of the center of mass velocity of the eclipsing stars of Algol indicate strongly that three bodies enter into this

system about the center of mass of which the eclipsing pair revolve in a nearly circular orbit with a radius of not less than 89,000,000 km., a period of 1.899 years and an epoch of minimum radial velocity at the date, 1901.85.

The variations observed in the eclipse period of this star, as well as those suspected in the eccentricity, are possibly largely due to perturbations arising in such a system.

As a consequence of the orbital motion of the center of mass of the eclipsing pair a variation in the time of light minimum with a range of ten minutes and a period of 1.899 years should be shown by photometric observations.

Achromatic and Apochromatic. Comparative Tests. Preliminary Communication: E. D. ROE, JR.

To test them side by side, two visual telescope objectives, each of the two-lens type, an achromatic and an apochromatic of 2½-inch and 2⅝-inch aperture and 44 inches focal length, were ordered by the writer in March of Mr. Lundin, of the Clark Corporation, and of Steinheil Söhne, of Munich, respectively. Hartmann's Foucault knife-edge test as described in the *Astrophysical Journal* for May was tried by Dr. Saunders and the writer on Mr. Lundin's objective, both visually and photographically. Color screens were used for testing chromatic aberration. Four photographic plates of the objective were secured. The objective showed high excellence under these tests. For the laboratory manipulations and appliances involved the writer is greatly indebted to his colleague, Dr. Saunders. Mounted on a 6½ inch Clark equatorial with clock-work, the writer has tested the objective on double stars with splendid results. As the Steinheil objective was only recently received, the investigation is as yet unfortunately incomplete. Preliminary examination, however, raises the expectation that this objective will accomplish what its maker intended it should.

On a quick Visual Method of redetermining the Focus of a large Visual Refractor when used for Photography with a Color-screen: E. E. BARNARD.

Such a large telescope as the 40-inch refractor of the Yerkes Observatory changes its focus largely from changes of temperature. But the photographic focus of such an instrument, where a color-screen is used, having once been determined, can at any time be redetermined accurately, regardless of temperature changes.

The following is the method: Find the photographic focus by the usual method of exposure on the stars. Insert in an adapter on the plate-holder a high-power eyepiece with graduated scale on the tube. With the plate-holder set at the scale reading giving the best result, focus carefully with the eyepiece on a star, and record the reading on the scale of the eyepiece. At any other time, disregarding the temperature, etc., the plate-holder is set at the original scale reading for the best focus, the eyepiece is inserted and the visual focus read off. If it is so many millimeters shorter or longer than the original visual reading, the plate-carrier must be moved in or out by that extent. The plate will then be in the best focus for the moment. If a spider line is inserted in the eyepiece and is brought into the focal plane with the star, then any other observer can at any time determine the focus in a minute's time by bringing a star and the wires into focus and making the proper connections.

On the Focal Changes in Nova Persei and on the Focus of some of the Wolf-Rayet Stars: E. E. BARNARD.

In A. N. No. 4232, Dr. J. Hartmann finds that the spectrum of Nova Persei changed to the nebular condition in the fall of 1902. In 1906 it had again changed and was similar to that of the Wolf-Rayet stars. Observations in the rather long interval were lacking to show when the change from the nebular spectrum occurred.

Observations of the focus of this star were made at the Yerkes Observatory with the 40-inch in 1901, 1902 and 1903. They show a change in accordance with Dr. Hartmann's spectroscopic observations.

The focus rather suddenly became nebular about the first of October, 1902, when it was a quarter of an inch longer than for a star. This lasted until the middle of November of the same year, when it slowly returned to the stellar focus, becoming stellar about February, 1903. The last of these focal measures was made September 28, 1903. The result was —0.03 inch. This value was so small that the sign was not considered real. But for the fact that Dr. Hartmann found the Nova had finally reached a condition similar to that of the Wolf-Rayet stars, it may have a stronger significance than I supposed, for I find that those of the Wolf-Rayet stars I have examined, with the exception of one case, have their focus slightly shorter than for an ordinary star. The focal measures, therefore, verify Dr. Hartmann's results and show, furthermore, just when the change in the spectrum of the star occurred.

Approximate Ephemerides of Fixed Stars: G. C. COMSTOCK.

When only a moderate degree of precision is required, apparent places of the fundamental stars covering a period of many years may be given in very compendious form. Two tables of such places will be published elsewhere, one giving the coordinates of Polaris within a second of arc, for a period of twenty-five years, the other showing the apparent places of fifty equatorial stars for a similar period. The probable error of a right ascension for these clock stars is about two tenths of a second of time.

A New Form of Stellar Photometer: E. C. Pickering.

In this new form of stellar photometer, an artificial star is formed by allowing a small electric light, run by a storage battery, to shine through a minute hole, placed in the focus of a small auxiliary telescope. This telescope is placed at right angles to the main telescope and a piece of plane glass set at an angle of 45° reflects the artificial star into the eyepiece. A piece of opal or ground glass is placed over the hole, and the light of the artificial star is varied by moving the electric light, along the axis of the small telescope, by a known amount. The scale of the instrument accordingly depends on the law of the square of the distances, instead of on the laws of polarized light, or on the empirical law found for wedge photometers.

On the Character of the Light Variations of a Herculis: Frank Schlesinger.

This star has long been thought to be an irregular variable with a period of 35 to 40 days and with rapid fluctuations near minimum. Frost and Adams have shown it to be a spectroscopic binary. In the spring of this year it was placed upon the observing program of the Mellon spectrograph of the Allegheny Observatory and Professor Pickering kindly agreed to have it observed simultaneously at Harvard with the photometer. Our spectrograms were measured and reduced by Mr. Baker, who deduced a period of 2.05 days for the velocity variations, very different from that assigned to the light variations. In discussing these observations with Mr. Baker it occurred to us that the star might be an Algol variable. The character of the spectrum and the form of the orbit (especially the small eccentricity) and most of the observations concerning its light, are in conformity with this idea. Mr. Wendell's observations at Harvard showed that this surmise is correct, and further proved the existence of a secondary minimum, so that the star is more properly of the Beta Lyræ type than of the Algol type. With the help of a diagram it may be shown how all the observed phenomena concerning this star can be explained and how the erroneous conclusions concerning the period and the fluctuations at minimum arose. The case is interesting as showing the intimate connection between photometric and spectrographic observations, the true character of the light variations being first indicated by the latter.

Photographic Light-curve of the Variable Star SU Cassiopeiæ: J. A. Parkhurst.

A lantern-slide was shown of the mean light-curve of this star derived from 86 extra-focal images taken with the Zeiss 6-inch doublet between October 19, 1906, and April 5, 1908. The plates were measured with a Hartmann "Mikrophotometer" and reduced with the writer's "absolute scale." The observations were best represented by a period of $1^d.9498$, giving a correction of $-0^d.0008$ to Müller and Kempf's period.

The range in magnitude found was 0.47, from 6.52 to 6.99. Compared with Müller and Kempf's range of 0.33 (5.93 to 6.26), this gives a color-intensity of 0.59 magnitude at maximum and 0.73 at minimum; the difference being similar to that found for other variables of short period. The star's spectrum is *F* 3 *G* on the Harvard classification. The radial velocity, as determined from 9 one-prism plates taken with the Bruce spectrograph and 40-inch refractor, is about −7 km., with but slight variation between the different plates.

This star has about the smallest range of any well-attested variable, but presents no difficulties to the extra-focal method.

(To be published in the *Astrophysical Journal.*)

On the Irregularity of the Proper Motion of the Star Krueger 60: E. E. Barnard.

From observations with the 40-inch refractor of the Yerkes Observatory, the parallax of *Krueger 60* was determined. The resulting value was $\pi = +0''.247 \pm 0''.010$. This agrees closely with the values determined by Dr. Schlesinger and also with that by Dr. Russell, the three values being:

Barnard	$+0''.247$	$\pm 0''.010$
Schlesinger	$+0''.248$	$\mp 0''.009$
Russell	$+0''.258$	$\mp 0''.013$

One of the components of *Krueger 60* is a rather wide double star, found by Professor Burnham in 1890, of the magnitude 9.3–11.0. The distance between the components is about $3\frac{1}{4}''$,

and they are in rapid orbital motion. During the investigation for parallax, it was found that the proper motion of the larger star, as determined from comparison with other stars, was slowly changing its direction, having in the past six or seven years changed about 8° or 9°, from 239° to 247°. This is undoubtedly due to the orbital motion of the two stars. It shows that the small star must have a rather large relative mass. The masses of these two stars can be accurately determined by measuring the position of *A*, with reference to near-by stars.

The Cœlostat Telescope of the Dominion Observatory: J. S. PLASKETT.

This paper contains a description illustrated by lantern slides of a new installation for solar research at Ottawa. A cœlostat and secondary mirror, each of 20 inches aperture, feed a concave of 18 inches aperture and 80 feet focus. Owing to local conditions the beam from the concave has to pass under the secondary mirror to a focus in the basement of the observatory. Notwithstanding the different and less advantageous conditions the solar definition is in general very good, much better than obtained with the refractor more suitably situated. The cœlostat is covered by a house, moving back on rails and the beam passes through a shed and short tunnel to the focus. Both house and shed are thoroughly louvered. A grating spectroscope of the Littrow form, with Brashear 6-inch objective of 23 feet focus, and Michelson plane grating ruled surface, $4\frac{1}{4} \times 4\frac{1}{4}$ inches, arranged to rotate around its optical axis, will be used with this telescope for spectroscopic investigation of the solar rotation, sun spots, etc.

Camera Objectives for Spectrographs: J. S. PLASKETT.

This paper contains an account of tests for definition and flatness of field performed on a number of different types of lenses used in and especially made for spectrographic work. The advantages of some new forms by Brashear and Zeiss over those previously used is illustrated diagrammatically. For work with a single prism a new objective by Brashear with widely separated elements, both of the same material, light crown, gives the best field, while for three-prism work another single material by Zeiss, in this case of the prism material, performs most satisfactorily. Neither of these forms can be used with larger angular aperture than *f*/10. For shorter focus lenses the Zeiss Tessar seems to be most suitable. A description of the effect upon the definition and flatness of field of changing the separation of the elements will be given.

The Distribution of Eruptive Prominences on the Solar Disk: PHILIP FOX.

This communication reviews a paper presented to the American Association for the Advancement of Science at the Chicago meeting on "The Detection of Eruptive Prominences on the Solar Disk" and summarizes the observations on their distribution as follows:

Spot birth is always accompanied by and generally preceded by eruptions. While the spot continues active the prominences will be present, generally following it at the edge of the penumbra. Spots beginning to decline are also accompanied with eruptions which will be seen at the ends of the bridges. In the case of complex spots where we have a large leader spot and another at the tail of the stream the eruptions follow the preceding spot and precede the following spot and are seen among the smaller spots of the stream. Eruptions are rarely seen preceding the leader spot and as seldom found following the trailer.

The eruptions about the spot groups are probably due in part to the interference of the whirls about the spots. Judging from the direction of motion indicated by the whirls of calcium and of hydrogen shown on the spectroheliograms, and from motion in some of the prominences, I find the direction of the whirls in the northern hemisphere as counter-clockwise and clockwise in the southern.

The Work of the Nautical Almanac Office: M. UPDEGRAFF.

The *American Ephemeris and Nautical Almanac* is one of five similar publications, and was first issued for the year 1855 at Cambridge, Mass., under the direction of Lieutenant (afterward Rear-Admiral) Chas. H. Davis, U.S.N. The American Nautical Almanac Office was established in the year 1849, was removed from Cambridge, Mass., to Washington, D. C., in 1866, and after occupying from time to time various quarters in the Navy Department and elsewhere in the city of Washington, was located in the main building of the new Naval Observatory in 1893. During the first forty-eight years the *Almanac* had four superintendents, and during the remaining eleven years six directors, the title of superintendent having been changed to director in 1893.

Professor Simon Newcomb, U.S.N., was superintendent and director for twenty years, 1877 to 1897, and during that time there were published under his direction eight volumes of the "Astro-

nomical Papers" of the *American Ephemeris* as well as the yearly volumes of the *Ephemeris* during that time. During the past eleven years the accuracy of the computations for the *Ephemeris* has been improved, a catalogue of zodiacal stars published, and orbits and ephemerides of certain new satellites of the planets computed. The next volume to be issued is that for the year 1912. It is intended hereafter to leave out the lunar distance tables, to insert the ephemerides of about 300 additional fixed stars, and to substitute for the Struve-Peters constants the constants adopted at the conference of directors of national ephemerides held in Paris in May, 1896. Among minor changes which are under consideration may be mentioned:

(*a*) Moon culminations given for lower as well as for upper culmination.

(*b*) A more convenient arrangement of ephemerides of satellites of the planets.

(*c*) Ephemerides of the brightness of the planets in terms of stellar magnitudes.

(*d*) Ephemerides for physical observations of the sun, moon and planets.

The second edition of the American *Nautical Almanac* for 1909 will contain a star list and map for the use of navigators, and it is hoped later on to add certain tables and ephemerides for the convenience of surveyors and engineers.

Definite suggestions as to possible improvements in the *American Ephemeris and Nautical Almanac* from astronomers, navigators and others who make practical use of that publication, are desired, will be carefully considered and should be addressed to "The Director, Nautical Almanac, U. S. Naval Observatory, Washington, D. C."

The American Nautical Almanac Office cooperates with the British Nautical Almanac Office in certain lines of work, and is also at present cooperating with Professor Simon Newcomb, U.S.N. (retired), in his lunar researches and in a revision of the orbit of Mars. The present superintendent of the Naval Observatory, Admiral Wm. J. Barnette, is disposed to promote the cooperation of the Department of Astronomical Observations of the Naval Observatory with the Nautical Almanac Office, especially as regards the meridian work of the observatory and the places of the fixed stars given in the *American Ephemeris*.

The distributing list for the *American Ephemeris and Nautical Almanac* has recently been enlarged by more than 50 per cent., and that for the "Astronomical Papers" has been more than doubled. The former publication is sent to libraries, though not, as a rule, to individuals, while the "Astronomical Papers" are widely distributed to scientific men and institutions throughout the world.

A considerable number of sets of the "Astronomical Papers," eight quarto volumes bound in cloth, are now available for free distribution, as also are a number of volumes and parts of volumes for the completion of sets, carriage free within the limits of the United States. There are also several hundred copies bound in cloth of an interesting and valuable book on "Astronomical Constants," a supplement to the *American Ephemeris* for 1897, which will be mailed free to those who apply for it.

The publications of the Nautical Almanac Office are no longer sold by the office. On October 1, 1906, the sale of these publications was transferred to the superintendent of documents, Government Printing Office, Washington, D. C.

On an Infinite Universe: G. W. Hough. (Published in *Popular Astronomy.*)

The Luminosity of the Brighter Lucid Stars: George C. Comstock.

Parallaxes have been determined for about three fourths of all stars brighter than magnitude 2.5. These are here utilized to determine the intrinsic brightness of each such star and to derive from these a curve showing the relative frequency of occurrence of the several degrees of luminosity among the stars in question. A theoretical distribution curve for these luminosities, derived from the hypotheses with regard to stellar distribution that are commonly made, is shown to be widely divergent from the curve above found. The cause of this divergence is sought in the hypotheses upon which the theoretical curve is based and it is shown that the theoretical and observed distributions may be brought into agreement by either of the following suppositions:

(*a*) The intrinsically brightest stars are not widely distributed through space, but manifest a distinct tendency to cluster about the sun.

(*b*) There is a sensible absorption of light in its transmission through space, of such average amount that a star having a parallax of a tenth of a second appears one magnitude fainter than it would appear in the absence of absorption.

Photographic Determinations of Stellar Parallax with the Yerkes Refractor: Frank Schlesinger.

This paper is an informal report on work done with the 40-inch Yerkes telescope under the

auspices of the Carnegie Institution, from 1903 to 1905. The methods and precautions adopted for making the photographs and for measuring and reducing them were described in some detail and the results exhibited for twenty-three stars. This paper is to be published in the *Astrophysical Journal.*

Measurement of Starlight with a Selenium Photometer: JOEL STEBBINS.

This paper presents the results of experiments on the use of selenium in stellar photometry. It is well known that the crystalline form of selenium decreases its electrical resistance when exposed to light. The method is to cast an extra-focal image of a star upon a selenium surface, and note the effect by means of a galvanometer. Using a 12-inch telescope, it has been possible to measure first and second magnitude stars with about the same accuracy that is obtained in visual methods. Tests with brighter artificial lights give a probable error of less than one per cent. for a single measurement.

In the course of a year the sensibility of the apparatus has been increased one hundredfold, and it is hoped that further improvements in the elimination of disturbing factors will produce extremely accurate results.

Spectrographic Observations: E. B. FROST.

A favorable report may be made upon the result of re-annealing by the original maker, M. Parra-Mantois, of Paris, of the three large flint prisms first made for the Bruce spectrograph and discarded on account of lack of homogeneity.

The star 46 (Upsilon) *Sagittarii*, which has been qualitatively studied by Miss Cannon at Harvard, and was found to be a spectroscopic binary by Campbell some years ago, has recently been observed, and a number of plates have been measured by Dr. D. V. Guthrie. He finds a range of velocity from + 55 km. to — 25 km. The bright lines are not conspicuous on our plates, and can be seen with certainty only on the thirteenth plate.

Observations of the fainter component of *ζ Ursæ Majoris* (*Mizar*) have been continued for several months, the measures being made by Mr. Lee. A careful study by the writer has failed to bring out a regular periodicity in the radial velocity, and the indications are that more than two bodies are involved.

Mention was made of certain new spectroscopic binaries:

φ Sagittarii ($18^h\,39^m$, $-27°\,6'$), of Orion type, which shows a large range of velocity.

β Trianguli ($2^h\,4^m$, $+34°\,31'$), Ia2, which was suspected from preliminary examination here, and established by measures of the same plates at Columbia University by Professor S. A. Mitchell.

55 *Ursæ Majoris* ($11^h\,14^m$, $+38°\,44'$), Ia2, found by Mr. Lee; range thus far: 40 km.

ι Andromedæ ($23^h\,33^m$, $+42°\,43'$), of Orion type, found by Mr. Barrett, probably of rather long period.

The Figure of the Sun and Possible Variations in its Size and Shape: CHAS. LANE POOR.

The first part of this paper contains a résumé of the more important investigations of von Lindenau, Secchi, Auwers, Newcomb and Ambronn. In practically every case the original reductions showed periodic variations in the diameter of the sun. Auwers discussed an immense mass of meridian circle and heliometer observations and reached the conclusion that the sun is sensibly a sphere and that the observed variations are due to personal and instrumental causes. This conclusion, however, was reached only by attributing variable personal equations to the different observers.

The second part contains a retabulation and rediscussion of the heliometer observations used by Auwers and of those made by Schur and Ambronn. It is here shown that these observations indicate a periodic variation in the shape of the sun, the period being the same as that of the sun-spot cycle. The observations of Schur and Ambronn were also investigated for short period vibrations by means of the method of "Time Correlation" as developed by Newcomb. These observations indicate a semi-permanent fluctuation in the shape of the sun having a period of about 28 days.

Results of Photometric Investigations: E. H. SEARES.

Light-curves were shown for RS *Draconis*, VY *Cygni*, RV *Tauri*, SU *Andromedæ*, RS *Bootis*, 52.1907 *Ophiuchi* and 43.1907 *Draconis*. All are interesting and unusual types of variation. The last four are of the so-called Antalgol type with periods ranging from ten to sixteen hours.

In addition, there was presented a simple and general method of determining the circular elements and relative dimensions of a binary system on the basis of an observed light variation of the Algol type. The arrangement of the method is such that the light-curve corresponding to the first approximation for the elements and dimensions must be tangent to the observed curve at two points. Differential formulæ can then be

used for improving the agreement of the calculated and observed curves. The application of the method to a considerable number of cases can be facilitated by the use of tables.

The Temperature Gradients of the Atmosphere and an Attempt to Account for the Upper Inversion: W. J. Humphreys.

During the past few years many sounding balloons, equipped with registering apparatus, have been sent up from different places and under different conditions to altitudes ranging from twelve to twenty kilometers, and observations have been secured indicating a division of the explored atmosphere into the following three regions:

1. A layer some 3,000 meters thick next the surface, in which the change of temperature with elevation is irregular and often locally reversed.

2. A region of fairly uniform and rapid temperature decreases with elevation extending from the top of the first layer to the high cirrus clouds.

3. The upper inversion, or the region above the cirrus clouds, when the temperature slowly increases with elevation.

The upper inversion is due primarily, but not wholly, to long wave radiation from the earth as a planet, and to which water vapor is a black body. When the temperature of the high atmosphere is 218° C. absolute, it can be shown that the temperature of the effective radiating surface is about 260° C. absolute.

Effect of Increasing the Slit Width on the Accuracy of Radial Velocity Determinations: J. S. Plaskett.

Experiments at Ottawa have shown that exposure time is almost proportionally decreased with increase in slit width to about 0.075 mm. Six spectra of β Orionis were made for each of four slit widths—0.025, 0.038, 0.050 and 0.075 mm. —at three different dispersions. The accidental errors of setting, as measured by the probable errors of the velocity from a single line obtained from the six plates in each series, are only slightly increased, scarcely at all in the higher dispersion, by increase in slit width to 0.075 mm. A further discussion shows that the increase of systematic error, so far as it may be determined from the limited number of plates, is also small with high dispersion, although quite marked for a slit 0.075 mm. wide with low dispersion. These somewhat unexpected results show that for stars with single lines the slit may be much widened without much loss of accuracy and with a considerable saving in exposure time.

The Algol System, RT Persei: R. S. Dugan.

With a Pickering polarizing photometer with sliding achromatic prisms, a series of 14,048 settings on RT *Persei* was completed in February, 1908. Most of the observations were made without a recorder.

The period is obtained from nineteen more or less thoroughly observed minima.

The mean curve shows a primary minimum of 1.33 magnitudes' range and a secondary of 0.16, each lasting about four and one quarter hours.

The curve between minima is not a straight line. After recovering from primary minimum the curve rises steadily until it reaches the point midway between the minima, and from that point decreases very little until secondary minimum begins.

The residuals show a constant correction for the night, depending on the average hour angle at which the observations were made.

The eccentricity and inclination are small, the two stars are nearly of the same size, one has six times the intrinsic luminosity of the other, and the radius of the orbit is three times the radius of the stars.

Observations of the Total Solar Eclipse of January 3, 1908: W. W. Campbell.

The paper summarized the more interesting results of the work of the Crocker Expedition from the Lick Observatory, with lantern-slide illustrations copied from the original negatives.

The corona was rather remarkable for the great number of long, straight and slender streamers extending in all directions. There was a conspicuous conical pencil of radiating streamers, near position angle 75°, whose vortex, if on the sun's surface, would lie within the largest sunspot group visible on January 3.

By far the greater part of the coronal light came from the areas lying within two inches of the sun's edge.

Polarigraphic negatives showed the existence of strong polarization in the coronal light, even up to the very edge of the sun.

A spectrogram with continuously moving plate recorded the changing spectrum of the sun's edge as the edge was gradually uncovered by the moon.

The spectrum of the corona was essentially free from absorption lines. Several new coronal bright lines were discovered. The maximum of continuous spectrum of the corona was displaced toward the red from that of the solar spectrum, indicating a lower temperature in the corona than in the photosphere.

The plates for the intra-mercurial planet search recorded more than 300 stars, including some of the ninth magnitude. All were identified as well-known stars. It is felt that the Lick Observatory observations of 1901, 1905 and 1908 bring definitely to a conclusion the observational side of this problem, famous for half a century. It is not contended that no planets exist in the intra-mercurial region, but it is believed that undiscovered planets do not exist in sufficient numbers to provide the mass necessary to explain the anomalies in the motion of Mercury and the other minor planets.

Value of the Solar Parallax from Photographs of Eros taken in 1900 with the Crosley Reflector: C. D. PERRINE.

The following determination of the values of the solar parallax is based on 823 images of Eros and the images of surrounding groups of stars contained on 281 photographs. These photographs were secured on eighteen nights from October 6 to December 24 inclusive.

The value of the solar parallax obtained is

$$8''.8054 \pm 0''.0025.$$

The measurements and reductions were made under a grant from the Carnegie Institution by Mrs. Moore and Miss Hobe.

The general results will be published in a Lick Observatory Bulletin, and a full account of the work by the Carnegie Institution.

HAROLD JACOBY
F. H. SEARS

THE CONVOCATION WEEK MEETINGS OF SCIENTIFIC SOCIETIES

THE American Association for the Advancement of Science and the national scientific societies named below will meet at the Johns Hopkins University, at Baltimore, during convocation week, beginning on December 28, 1908.

American Association for the Advancement of Science.—Retiring president, Professor E. L. Nichols, Cornell University; president-elect, Professor T. C. Chamberlin, University of Chicago; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, Dr. J. Paul Goode, University of Chicago.

Local Executive Committee.—William H. Welch, M.D., chairman local committee; Henry Barton Jacobs, M.D., chairman executive committee; William J. A. Bliss, secretary, Joseph S. Ames, William B. Clark, R. Brent Keyser, Eugene A. Noble, Ira Remsen, John E. Semmes, Francis A. Soper, Hugh H. Young.

Section A, Mathematics and Astronomy.—Vice-president, C. J. Keyser, Columbia University; secretary, Professor G. A. Miller, University of Illinois, Urbana, Illinois.

Section B, Physics.—Vice-president, Professor Carl E. Guthe, State University of Iowa; secretary, Professor A. D. Cole, Vassar College, Poughkeepsie, N. Y.

Section C, Chemistry.—Vice-president, Professor Louis Kahlenberg, University of Wisconsin; secretary, C. H. Herty, University of North Carolina, Chapel Hill, N. C.

Section D, Mechanical Science and Engineering.—Vice-president, Professor Geo. F. Swain, Massachusetts Institute of Technology; secretary, G. W. Bissell, Michigan Agricultural College, East Lansing, Mich.

Section E, Geology and Geography.—Vice-president, Bailey Willis, U. S. Geological Survey; secretary, F. P. Gulliver, Norwich, Conn.

Section F, Zoology.—Vice-president, Professor C. Judson Herrick, University of Chicago; secretary, Professor Morris A. Bigelow, Columbia University, New York City.

Section G, Botany.—Vice-president, Professor H. M. Richards, Columbia University; secretary, Professor H. C. Cowles, University of Chicago, Chicago, Ill.

Section H, Anthropology.—Vice-president, Professor R. S. Woodworth, Columbia University; secretary, George H. Pepper, American Museum of Natural History, New York City.

Section I, Social and Economic Science.—Vice-president, Professor G. Sumner, Yale University; secretary, Professor J. P. Norton, Yale University, New Haven, Conn.

Section K, Physiology and Experimental Medicine.—Vice-president, Professor Wm. H. Howell, Johns Hopkins University; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

Section L, Education.—Vice-president, Professor John Dewey, Columbia University; secretary, Professor C. R. Mann, University of Chicago, Chicago, Ill.

The American Society of Naturalists.—December 31. President, Professor D. P. Penhallow, McGill University; secretary, Dr. H. McE. Knower, The Johns Hopkins Medical School, Baltimore, Md. *Central Branch.* President, Professor R. A. Harper, University of Wisconsin; secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The American Mathematical Society.—December

30, 31. President, Professor H. S. White, Vassar College; secretary, Professor F. N. Cole, 501 West 116th St., New York City.

American Federation of Teachers of the Mathematical and Natural Sciences.—December 28, 29. President, H. W. Tyler, Boston, Mass.; secretary, Professor C. R. Mann, University of Chicago, Chicago, Ill.

The American Physical Society.—President, Professor E. L. Nichols, Cornell University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Chemical Society.—December 29–January 1. President, Professor Marston T. Bogert, Columbia University; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

The Geological Society of America.—December 29, 31. President, Professor Samuel Calvin, University of Iowa; secretary, Dr. E. O. Hovey, American Museum of Natural History, New York City.

The Association of American Geographers.—January 1, 2. President, Dr. G. K. Gilbert, U. S. Geological Survey; secretary, Professor Albert P. Brigham, Colgate University, Hamilton, N. Y.

The American Society of Vertebrate Paleontologists.—December 28–30. President, Professor Richard Swan Lull, Yale University; secretary, Dr. W. D. Matthew, American Museum of Natural History, New York City.

The American Society of Biological Chemists.—December 28–30. President, Professor John J. Abel, The Johns Hopkins University; secretary, Professor William J. Gies, 437 West 59th St., New York City.

The American Physiological Society.—December 29–31. President, Professor W. H. Howell, Johns Hopkins University; secretary, Dr. Reid Hunt, Hygienic Laboratory, 25th and E Sts., N. W., Washington, D. C.

The Association of American Anatomists.—December 29–31. President, Professor J. Playfair McMurrich, University of Toronto; secretary, Professor G. Carl Huber, 1330 Hill St., Ann Arbor, Mich.

The Society of American Bacteriologists.—December 28–January 2. Vice-president, Professor H. L. Russell, University of Wisconsin; secretary, Dr. Norman MacL. Harris, University of Chicago, Chicago, Ill.

The American Society of Zoologists.—Eastern Branch, December 29–31. President, Professor William Morton Wheeler, Harvard University; secretary, Dr. Lorande Loss Woodruff, Yale University, New Haven, Conn. *Central Branch*, December 28–30. President, Professor E. A. Birge, University of Wisconsin; acting secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The Entomological Society of America.—December 29, 30. President, Professor W. M. Wheeler, Harvard University; secretary, J. Chester Bradley, Cornell University, Ithaca, N. Y.

The Association of Economic Entomologists.—December 28, 29. President, Professor S. A. Forbes, University of Illinois; secretary, A. F. Burgess, Washington, D. C.

The Botanical Society of America.—December 29–31. President, Professor W. F. Ganong, Smith College, Northampton, Mass.; secretary, Professor D. S. Johnson, Johns Hopkins University, Baltimore, Md.

American Nature Study Society.—December 30, 31. President, Professor L. H. Bailey, Cornell University; secretary, Professor M. A. Bigelow, Teachers College, Columbia University, New York City.

Sullivant Moss Chapter.—President, Dr. T. C. Frye, Seattle, Wash.; secretary, Mr. N. L. T. Nelson, St. Louis, Mo. Address: Mrs. Annie Morrill Smith, 78 Orange St., Brooklyn, N. Y.

Wild Flower Preservation Society.—President, Professor Chas. E. Bessey; secretary, Dr. Charles Louis Pollard, New Brighton, N. Y.

The American Psychological Association.—December 29–31. President, Professor G. M. Stratton, University of California; secretary, Professor A. H. Pierce, Smith College, Northampton, Mass.

The American Philosophical Association.—December 29–31. President, Professor Hugo Münsterberg, Harvard University; secretary, Professor Frank Thilly, Cornell University, Ithaca, N. Y.

Southern Society for Philosophy and Psychology.—Convocation week. President, Professor J. MacBride Sterrett, The George Washington University; secretary, Professor Edward Franklin Buchner, The Johns Hopkins University, Baltimore, Md.

The American Anthropological Association.—December 28–January 2. President, Professor Franz Boas, Columbia University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—Week of December 28. President, Professor Roland B. Dixon, Harvard University; secretary, Dr. Alfred M. Tozzer, Harvard University, Cambridge, Mass.